Science

January 2, 1948

Edmund Ware Sinnott

President of the AAAS, 1948

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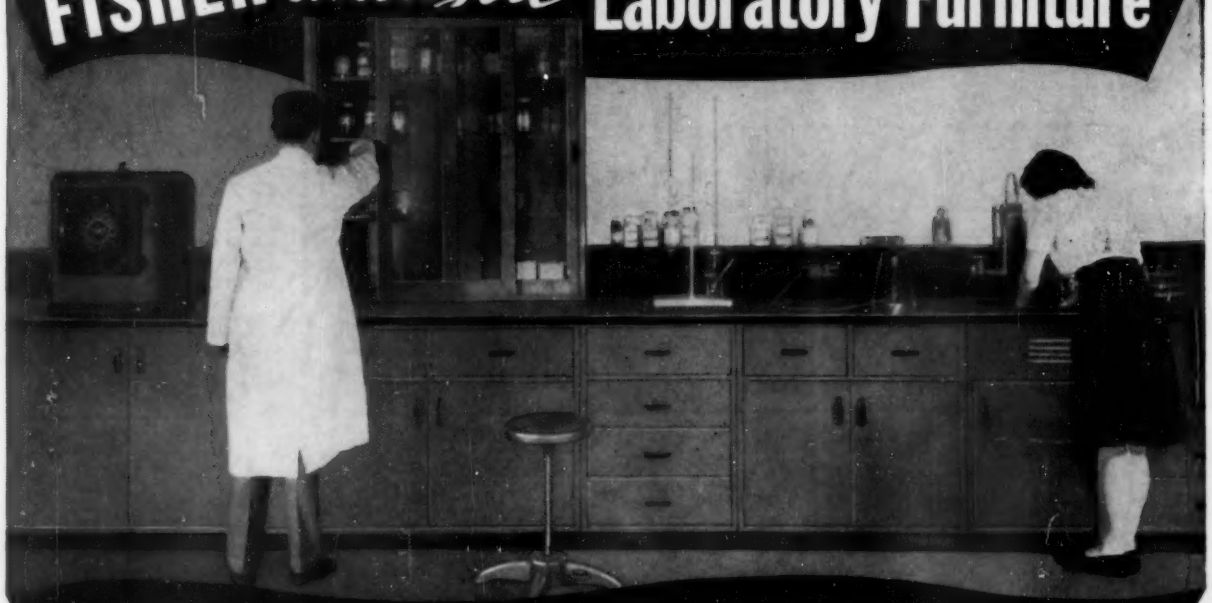

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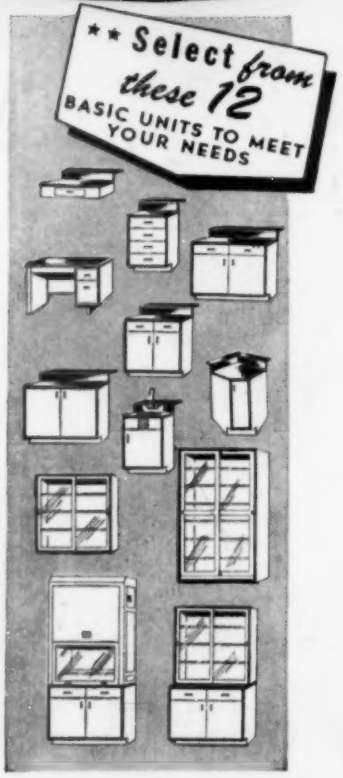

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Edmund Ware Sinnott: President of AAAS, 1948

Lewis Hanford Tiffany

Deering Professor of Botany and *Chairman of the Department, Northwestern University, Evanston, Illinois*

IT MAY SEEM STRANGE TO SOME that a noted botanist should express concern about the human species, not only as a mechanism of physical, chemical, and biological properties, but also as an individual having spiritual values and needs. Such an awareness is merely the evidence of a frank recognition that the world is sick and that science alone is not enough. Such a credo, though Dr. Sinnott would scarcely use the word, helps us to understand the many facets of the man who at present is head of Yale's Sheffield Scientific School, an institution now devoted exclusively to graduate work. Concerned with graduate study and recognizing its paramount importance to mankind, besides being a famous investigator in his own right, Director Sinnott neither overlooks nor minimizes the undergraduate curriculum. He would have college students study both the broad aspects of science and the fundamental structures of the humanities.

The new president of the AAAS got off to a flying start by being born in the environs of Harvard University on February 5, 1888. Sinnott was graduated from Harvard in 1908, took his Master's degree two years later, and was awarded the Ph.D. in 1913. During these years at Harvard, he held in turn the positions of Austin teaching fellow and assistant in botany, Sheldon traveling fellow for botanical research in Australasia, and instructor in wood technology. He served as professor of botany and genetics at Connecticut Agricultural College (1915–28), held a similar position at Columbia (1928–40), was appointed Sterling professor of botany and chairman of the department at Yale (1940), and became director of the Sheffield Scientific School in 1945. Sinnott has thus been associated with the traditions of great educational institutions, and this is not only a distinction but also a heritage and a challenge. That he has won the approval and admiration of his fellow scientists is attested by his election to the presidency of one of the great scientific organizations of the world.

Professor Sinnott has previously been honored, particularly by biologists, upon numerous occasions. He was starred in the third edition of *American men of science*. He has served as president of the Botanical Society of America (1937), the American Society of Naturalists (1945), and the Torrey Botanical Club (1931–34). He is a member of the National Academy of Sciences, American Philosophical Society, and the American Academy of Arts and Sciences. He served for 7 years as a member of the board of managers of the New York Botanical Garden and for 6 years as editor-in-chief of the *American Journal of Botany*.

Sinnott has been at Yale only since 1940, but he has already accomplished enough to win a botanical medal of honor, if such an award existed. In addition to the positions just enumerated, he is director of the Marsh Botanical Gardens, of the Osborn Botanical Laboratory, and of the University's Division of Sciences. The staff of the Department of Botany has trebled, graduate students in botany have greatly increased in number, and cooperative relations between the department and such institutions as the Forestry School and the Connecticut Agricultural Experiment Station have reached a high plane of success. In 1946, teaching and research in microbiology increased to such an extent that the department assumed the title of Botany and Microbiology. In addition, the department now offers a course in tissue culture. Sinnott's interest in general education is shown by the establishment this year of a general biology course, in which members of the staffs of botany, zoology, and psychology participate. In the midst of these activities he has found time to revise both his textbooks, work on a manuscript for a new book, and publish 21 papers.

Perhaps Professor Sinnott is most widely known through the publication in 1925 of the *Principles of genetics*, in which Professor Dunn served as co-author. The book has since undergone several editions and has proved to be one of the two or three outstanding texts in the field of genetics. *Botany: principles and problems* also made an important contribution to the teaching and study of plant science. It is a bit difficult to label a man of Sinnott's accomplishments, but if a label must be had, he is probably properly classified as a morphologist, although he is anatomist, geneticist, botanist, teacher, and administrator as well. His recent papers on various developmental phases in the growth of cucurbits indicate that we may soon be as well acquainted with gourds as with peas. It seems indeed fitting that the honor of the Association's presidency should be accorded Professor Sinnott in the midst of his greatest usefulness to science and to education.

Science and the National Welfare

E. U. Condon, *Director*
National Bureau of Standards, Washington, D.C.

SOCIETY IS AT THIS MOMENT at the threshold of an undreamed-of mastery of our material environment, for science, which provides that mastery, is in its Golden Age.

In particular, achievements in nuclear physics promise incredible advances in the years ahead. Energy from atomic power plants has been much talked about, but even more important are the tools provided by nuclear physics for research in other fields. Radioactive isotopes, for example, will permit us to explore the structures and constitution of molecular aggregates, for such isotopes can be introduced into a system as scientific detectives. They will behave as the usual atoms of the particular element behave, but they can be traced and studied by means of the radiation they emit. Tracer studies of this kind will unravel secrets in biology, physiology, medicine, chemistry, and metallurgy.

The combined effect of tracer studies, of a variety of sources of radiation, of various sources of high-intensity, highly-accelerated subatomic particles, and fundamental knowledge of the nucleus means that spectacular advances in many fields are at hand. The problem of curing fatal diseases will be successfully attacked; fundamental biological and physiological processes will be understood; new types of therapy will be developed in medicine; better control of intricate chemical manufacturing processes will be feasible; new products, like petroleum fuels and metals with unusual properties, will be possible; and even new forms of plant life can be created. The speed with which these possibilities are realized depends primarily on how much effort we put into such activities. For there is no question that the impetus of the new knowledge in nuclear physics, in conjunction with steady advances in other fields of science during the last 50 years, means a general efflorescence of the physical and life sciences.

But if we are to profit from this happy situation, there are major problems to be solved, and their solution will not wait. From one point of view life today is a race—a race between knowledge in the physical sciences, which gives material mastery, and general ignorance, which retards or rejects mastery of our environment. Rejection means no more and no less than destruction of civilization as we know and cherish it.

The problems confronting us, approaching them from the standpoint of the sciences, exist on several planes and two in particular: the specific problems of science as science, and the question of these sciences in relation to the other activities of man.

Problems of Science

The problems arising within the sciences themselves are extremely practical ones, and, on the whole, they are not complex. Several axioms are at once apparent. First, science is universal. Second, science is unlimited in its material. Third, the rate of scientific progress depends on the amount of effort put into science. These axioms are important: they mean that no individual and no nation has a monopoly in science, that science affords an inexhaustible mine of valuable knowledge and discoveries, and that we must be willing to support science appreciably if we expect to gain heavily and to maintain leadership.

The Steelman Report

A comprehensive and cogent analysis of the problems of science is to be found in John R. Steelman's report to the President, *Science and public policy.* Taking into account the three major groups engaged in research and development activities—the universities, the industrial laboratories, and the Federal research agencies—Dr. Steelman points out that each of these groups is "especially adapted to the performance of a particular type of research and each can make a unique contribution to our total research and development effort," with university emphasis on basic research, industry on development, and government laboratories engaged in both.

As a "basis for our progress against poverty and disease" and as the basis of national security, the Steelman report analyzes the present scope of our scientific effort, the deficiencies now present, and the needs in terms of a broad program. The main recommendations of the report are 8 in number, and I would like to discuss them briefly.

(1) It is recommended that expenditures for research and development be expanded as rapidly as facilities and trained manpower can be provided. A suggested goal is that, by 1957, 1% of the national income should be expended in research and develop-

An address delivered before the American Council of Commercial Laboratories at the Statler Hotel, Washington, D. C., December 4, 1947.

ment in university, industry, and government laboratories.

The report shows that a little over $1,100,000,000 is being spent this year for research and development, excluding the social sciences. With a national income of $200,000,000,000, this is an expenditure of little more than .5%. Only about $110,000,000, or less than 10% of the total, is spent for basic research. Almost half—that is, $460,000,000—enters into the development of military weapons and needs, not including the amount spent for atomic bomb development now considered to be a civilian activity.

(2) It is recommended that heavier emphasis be placed in the future on basic and medical research. More specifically, it is recommended that the total research and development budget be doubled, coincidentally quadrupling basic research activity and tripling research on health and medicine.

(3) It is recommended that support for basic research be provided by the Federal Government at a progressively increasing rate, reaching an annual rate of $250,000,000 by 1957. The present rate of total expenditures for basic research is $110,000,000, while quadrupling would require $440,000,000. This proposal, therefore, leaves ample scope for large-scale and expanding support of basic research by private groups and state governments.

(4) It is recommended that a National Science Foundation be established with a Director appointed by, and responsible to, the President to administer the program of grants in support of basic research. It is also recommended that the Director have a board of advisers, half of whom should come from government laboratories in order to provide for proper correlation of the work with that of the government laboratories.

(5) It is recommended that a program of Federal scholarship aid to university students be developed in order to provide for the proper training of the increased number of scientists needed and that this program be a part of a general program of assistance to university students in all fields of interest.

(6) It is recommended that suitable Federal assistance be given to colleges and universities in developing their scientific research facilities, and that this should be administered as part of a broad program of aid to universities in all fields.

(7) It is recommended that the work of the several Federal research establishments be better coordinated by the establishment of an Interdepartmental Science Committee, by a coordination of all scientific research programs through the Bureau of the Budget, and by the assignment of a number of the White House staff to devote himself to problems of liaison at the top policy level of the Federal Government.

(8) Lastly, it is recommended that aid to the reconstruction of European scientific research be made part of our European Recovery Program. This recognizes, first, that science is universal in that its truths are part of the universe accessible to all investigators; second, that we gain as much by original discoveries made elsewhere as by those which we make; and, third, that the progress of other nations in science and technology is necessary if they are to become self-sufficient again.

The program outlined in the Steelman report is splendidly conceived, and every point is vital if we are to live up to the responsibilities with which we are confronted by our good fortune in natural resources and freedom from war devastation.

One of the great obstacles in the way of a major program of expenditures on basic research is the difficulty of explaining to an appropriations committee—and even to management in private business—precisely what the program will accomplish with that degree of definiteness expected and demanded in other fields. It is necessary to entrust funds for research programs on faith, on the competence of the leaders of such programs, and the trust must be maintained for a sustained period of time. It is characteristic of most fundamental research that several years are required for the completion of any work of importance and that the end result may be difficult to evalulate by anyone except specialists. What, for example, is the cash value of Einstein's discovery of the relation, $E = mc^2$? No doubt it is an astronomically large value now. But what was its worth at the time of its formulation, and who was qualified to make the evaluation? The point simply is this: pure knowledge cannot be evaluated in cold cash, and pure knowledge is independent of such evaluations.

Unfortunately, appreciation of this fact is not as widespread as it should be, which suggests the story of two partners who had long operated a chemical manufacturing business. They finally decided to employ a research chemist. Along about 11 A.M. of the first day of his employment, one partner said to the other, "Shall we go see whether that research chap has discovered anything?" "No," replied his partner, "It's a little too soon. Let's wait until after lunch."

Zones of Danger and Weakness

One of the dangers facing us in the present situation is overconfidence. The United States has led the world in technological progressiveness and in the techniques of mass production. We are, without question, the most powerful nation in the world. In these very facts lies the essential danger, for overconfidence is a product of precisely this set of circumstances. Illustrations of pride preceding fall fill the pages of his-

tory, and civilization after civilization has perished in this fashion. We need glance backward no farther than the recent war to see a once scientifically sophisticated power lose leadership and initiative—Germany. For many years, during the latter half of the 19th century and the early 20th, science in Germany was in a position of international prominence, and yet we now know how misguided and superficial were their efforts in the direction of atomic energy. I believe that two factors were at play here: First, the Nazi leaders eliminated the truly first-rate scientific leaders and installed second-rate party-men in positions of scientific leadership. Second, there are obvious evidences of overconfidence on the part of the scientists as well as the nation in their scientific ability and achievement. Thus, after the revelation of our work in atomic energy, we had the spectacle of, first, the German refusal to believe that accomplishment, and second, childish attempts to pretend that they had not wanted to develop an atomic bomb but that they really had progressed in atomic research and that their researches were to be devoted to peacetime uses. The rationalizations would be merely amusing were they not also sardonic.

Again, we have the spectacle of England's dilemma in this century. Prior to the 20th Century, the English had led the world in technology, one of the consequences of their early industrialization. This leadership had lulled the British into accepting this pre-eminence almost as a law of nature, and progress in modernization of facilities and in mass-production technique was not pursued vigorously. The result was that England fell behind Germany and the United States. A reluctance to accept scientific advances, in the face of obsolescence, is thus dangerous.

The obvious lessons of the past, as far as science is concerned, indicate that competent leadership must be fostered in science (remember that for every thousand scientists adequate to contribute in a rather routine way there is only one with great and inspiring creative ability), and we must never take for granted future achievements on the basis of past performances. This thought leads to another danger confronting us: as a nation we have been outstanding in applying science; we have not been outstanding in basic scientific discoveries or theory. If we are to attain our goals, it is imperative that basic research be supported on a large scale.

In atomic energy, for example, we were essentially dependent upon the work of European scientists for our basic knowledge, and European scientists in this country contributed heavily to our success, in particular Fermi and Szilard. Again, during the first half of the war, we were dependent on British research and development in radar for our own program, and it was not until the latter portion of the war that we contributed in a basic way to this field. Then our contributions, particularly in microwaves, were significant.

Research in Rubber

Still another field, vital to our economy, in which we have been dependent on European research is rubber, representing in the recent conflict a vast Federal investment second only to atomic energy and radar. The need for synthetic rubber during the war, as a result of the unavailability of natural rubber, is well known. What is not so well known is that the synthetic rubbers we used were developed largely by the Germans. The four types of synthetic rubber which we produced during the war were GR-S, Neoprene, Butyl, and the Nitrile rubbers. Of these, only Neoprene is purely American, a development of the Du Pont Company. Butyl is partially an American development, for it constitutes a radical improvement of the German material, polyisobutylene; yet it was based on this German work. Fundamental patents were taken by the Germans on the remaining two types—the Nitriles (under the German name Buna-N) and GR-S (under the German name Buna-S)—in the early 1930s. Of all these rubbers, GR-S is the most important: more than 80% of our total production was of this type because it is not only cheaper but best for tires.

Now that natural rubbers are again available, the problem of what to do with the synthetic industry, which involved a Federal investment of more than $700,000,000, is acute. This industry will be called on for only limited production, primarily to insure plant potentialities in the event of any future emergency and to provide the synthetic product for certain applications. The magnitude of the investment, the size and scope of the plants, and the relations between the synthetic and natural commodity are major commercial problems. For this very reason, the need for continued research and development is obscured.

The National Bureau of Standards has long been active in the research and development phases as they pertain to both synthetic rubbers and natural rubbers. From the standpoint of the national economy and security, it is necessary that a major and coordinated program of research and development be maintained in this field. Basic research is necessary if new types of synthetic rubbers are to be developed; developmental research is needed to develop desirable characteristics in the rubbers now available, to determine their properties. Much also remains to be done in measurements and instrumentation associated with the synthetic rubbers.

In the future, this country must have a vigorous program of rubber research to maintain "a techno-

logically advanced and rapidly expandible domestic rubber-producing industry" as part of our national policy outlined in the Crawford Act (Public Law 24, 80th Congress). The cost of such a program would involve an annual expenditure of about $4,000,000, which is less than 1% of the amount spent for the 1,000,000 tons of rubber that this country consumes annually. Industry should expend a corresponding amount for the development of new rubbers, in addition to its expenditures for research on end-products.

The cost of such a program is actually relatively small in terms of the value of the commodity and in terms of its national importance. Merely to maintain the present synthetic plants in a stand-by condition involves an annual expenditure of over $8,000,000, and these plants may well be obsolete at the time of another emergency. Therefore, a Federal expenditure of half this, to insure our future in this field, is, from any practical point of view, trifling.

Research in Optical Glass

A comprehensive and broad program of research in the field of synthetic rubber is a matter of national wisdom, and similar programs are needed in other fields, many of them not of such vital concern on the surface. For example, a national program of basic research on optical glass is a primary desideratum, and yet the thought of the importance of optical glass is not likely to occur to those not engaged directly in military problems, because the annual requirements of this country for precision optical instruments for civilian purposes during a period of peace are almost negligible when compared with the demands made upon our industry by our military agencies during war.

Here is a field in which we were long dependent on European developments. Prior to World War I, all optical glass used in this country was imported from abroad. It was during this period, under the sponsorship of the Navy, that the Bureau started experiments on the production of optical glass and succeeded also in fulfilling military requirements during that conflict; but this was possible only because the United States did not enter the war until the fighting in Europe had been going on for over two years. In the years between World War I and World War II, experimental work was supported at the Bureau by the Navy Department as a hedge against any future emergency, and the foresight of the Navy Department was amply rewarded in the recent conflict, for not only were satisfactory types of glass available as a result of prior experimentation, but actual production in this emergency period was necessary by the Bureau, attaining a peak of 236,000 pounds in 1943. Moreover, the Bureau was able to train industrial engineers and technicians so that their plants could enter into the production of this specialized kind of glass, and assistance was rendered to other branches of the military establishment.

If we are to be again prepared for future eventualities, a program of research and experimentation must be maintained. Stockpiling of optical glasses is not a solution, for stockpiles tend to maintain the status quo, saddling the military services with obsolete instruments and making the introduction of better glasses and instruments difficult. As a general rule, with valid exceptions only in the case of basic raw materials, stockpiling is futile, for it tends to hinder progress.

The only sensible solution is a progressive research program involving the development of new types of optical glass, analysis of the chemistry and physics of such glasses, the development of new and more efficient methods of making and processing optical glass, the investigation of new optical materials for such systems as the ultraviolet and infrared, studies of polished surfaces, and the development of control methods in production of highly precise optical components.

Research in Buildings and Structures

Finally, let me mention a field somewhat removed from pure science and related more to applied science and engineering—building technology. The need for research in this field needs no stressing in this critical period of housing shortages, but it is significant to note the technical reasons behind our apparent backwardness in this field. In almost every field where American science and industry have teamed together to produce spectacular results, production has involved a centralized operation—for example, the production of automobiles, tires, typewriters, and so on. In the building industry, however, no single firm has specialized in the production of a building as such, and practically every material and product known enters into a completed structure. In each of the fields supplying components for a building, research has been done, depending on various conditions too many to outline here, and varying tremendously in extent and scope. No one, on the other hand, has attacked the problem from an integrated point of view, with the single exception, to my knowledge, of the work of the Bureau of Standards in building materials and structures.

Even here, as a result of the extremely limited funds granted for this purpose, the attack has been on a relatively small scale. Recently, all of the sections engaged in this type of work at the Bureau have been unified into a consolidated Building Technology Divi-

sion, and an accelerated and coordinated program is under way. Groups are engaged simultaneously in investigations of the properties of materials: structural strength; fire resistance; acoustics and sound insulation; heating, ventilating, and air-conditioning; durability and the exclusion of moisture; building and electrical equipment; and other projects.

Unified scientific research in other fields of industry has been responsible for productive results, and it is reasonable to assume that the effect of this approach, applied generally throughout the $10,000,000,000 construction industry, will achieve similar results.

Science and Man's Other Activities

Even these few illustrations indicate that science does not function in a vacuum, divorced from everyday life. It is a pre-eminently practical thing, dealing with crucial problems affecting industry, business, the nation, and the world. It costs money, and it demands the efforts not only of scientists but of every segment of our population. Too often science is pictured as an "ivory tower" affair with no, or little, relation to reality. On the contrary, it is concerned immediately with the nature of the universe. It is the cause of our industrial economy, it operates within the full context of social existence, and it deals with practical problems as much as, if not more than, with theoretical ones. One of the discouraging attitudes widely prevalent in the contemporary world is the high regard placed upon what is called "practical" and the low esteem granted the "theoretical." In point of fact, the two differ only in time, relative to application; and pure, fundamental knowledge precedes applied knowledge.

The operations and progress of science can therefore be understood fully only in terms of the framework of our general society and in relation to the other activities of man. This context is particularly significant when we consider that science has now placed in our hands tools that are equally potent for good or evil. I have been talking, for the most part about the good, but actually the potential evil is more important, because of what value is this growing potential of good if science is used to destroy the civilization from which it has sprung?

It is fashionable to cry down the so-called pessimist who suggests this dangerous possibility, partly because no one loves a pessimist, partly because man is largely a hopeful creature with a belief that, at worst, he will muddle through, and largely because the dangers are difficult to group and appraise as a consequence of the staggering difference in kind and degree of present dangers in the form of scientific warfare. It is sufficient to say for my purposes that science has presented us with several weapons, each of which, unleashed, can mean almost total, if not total, destruction.

The question, then, is how to prevent such a situation. The answer is not to be found in the physical sciences. It is to be found in other realms of man's activity—in economics, in sociology, and in political science. Man's conduct in the physical sciences is rational; in these other fields it is largely arbitrary.

Research in the "Humane" Sciences

It is often said that man's social irrationality is a consequence of the fact that economics, sociology, and political science are not sciences but merely individual judgments and personal opinions. Now this is palpably untrue even at present, for much is known about cause and effect in these fields, and such statements are made only because habit, custom, tradition, and heritage tend to make us cling to whatever we know rather than to re-examine the data, coolly and critically. So far, no readily demonstrable experiments exist in what I shall call the "humane" sciences as exist in the physical sciences.

Admittedly, these "humane" sciences are younger than the physical sciences. Moreover, the variables to be accounted for are vastly greater than those we deal with in the physical sciences. But these are not adequate reasons for belittling the "humane" sciences and denying them support. On the contrary, these are compelling reasons for supporting them, and the present state of civilization demands that this be done. As a matter of fact, since the physical sciences have outstripped man's capacity for using them wisely, sanely, religiously, it is of the utmost urgency that we attempt to forge ahead in the "humane" sciences lest all be lost.

This is the time for intensified activity in these fields, not only because of the urgency of our need but because now the physical sciences have two tremendous tools to contribute to the "humane" sciences, tools that will permit "scientific" analysis of data having a large number of variables.

The first of these tools is statistics, which provides the theoretical, mathematical basis for analysis, the mathematical techniques for handling data, and the criteria for evaluating results. Mathematical statistics is now a substantial and well-developed discipline, and it does, in fact, offer these tools. Automatic electronic computing machines, on which many laboratories and companies are at work, constitute the second tool shortly to be available to the "humane" sciences. These machines will permit the handling and analysis of data, rapidly and comprehensively. Until the present, one of the major problems in fields where vast amounts of data are obtained has been the handling and classifying of the data. Literally

thousands of man-days are needed in even relatively simple problems. This means that research is expensive, and the "humane" sciences have not usually been able to afford such luxuries. As an example of the labor involved in handling data of this type, consider a relatively simple problem. At the present time, a typical census problem involving 100,000 pairs of 5-digit numbers, representing statistical data, takes approximately 12 working days, exclusive of card handling and data punching. An electronic digital machine will handle the same sequence in 10 minutes at the most.

The Steelman report does not consider research in the economic, social, and political sciences. The study of the physical sciences in itself was a major effort, requiring 5 volumes of summary findings. It is to be hoped, however, that a similar analysis of the "humane" sciences will be made in the near future and that a program for these sciences will be mapped out and implemented.

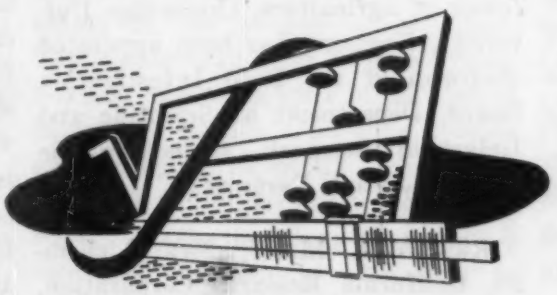
Research in the "Mental" Sciences

Just as there is a disparity in the evaluation of research between the physical and the humane sciences, so too there appears to be an analogous disparity in the attitude of most people toward research between the medical and the "mental" sciences. Like the physical sciences, the medical sciences produce what are called "tangible" results—for example, new drugs, new clinical techniques, and so on. Like the "humane" sciences, the "mental" sciences do not appear to produce materialistic results and have suffered similarly in the support granted them for research. This, too, is a situation that needs remedy. Psychology, psychiatry, and psychoanalysis are disciplines pertinent in the solution of current problems. Aside from the statistical fact that 3 out of every 7 beds in the hospitals of the United States are occupied by the mentally ill—a vast drain in terms of lost manpower and cost—and that untold numbers of borderline cases permeate the entire social structure, we need to know more about the workings of the mind. For there is little doubt but that nonevident factors affect human behavior profoundly, factors like frustrations and fears.

These factors affect every activity of man, his personal, social, political, and even scientific life. From the standpoint of science we can say not only that science affects individuals and nations but that these individuals and nations affect science. Even from this restricted approach, then, what has happened or happens to men's minds and spirits is of interest if we have scientific objectives in view. We have seen how entire nations have apparently succumbed to a schizophrenia that has led to the espousing of mad, undemocratic, bestial beliefs. We have seen at least one nation despoil its scientists as a result of such an aberration.

Compartmentalization in the sciences and in other fields is inimical to a coordinated attack on the problems of man. This compartmentalization is actually breaking down in the sciences. The distinction between chemistry and physics, for example, has almost vanished. Competent research in the social sciences now depends on mastery of mathematics and on the utilization of the electronic tools. The complexity of modern life depends on specialization for progress in particular fields but, for over-all progress and for a solution to the dilemma of unbalances, integration and coordination are essential. In short, education of a comprehensive nature, embracing many fields, is needed for the survival of our civilization.

The sciences, like those other truth-seeking activities of man, require a free environment, an environment, above all, free from fear, petty arbitrariness, and tyranny. The pursuit of the sciences is fundamentally nothing more or less than the pursuit of truths. In the last analysis, all of man's activities are subservient to what happens to his spirit—to his spiritual welfare, "For what shall it profit a man, if he shall gain the whole world, and lose his own soul?"



NEWS and Notes

With over 4,000 scientists registered by midafternoon of December 27, the 114th Meeting of the AAAS in Chicago was well on its way to becoming one of the largest yet held.

On Saturday afternoon the Grand Ballroom of the Stevens Hotel was filled to capacity by scientists, their families, and friends to hear Harold F. Weaver, of the Lick Observatory, University of California, describe the Army Air Forces–National Geographic Society Eclipse Expedition to Brazil in the spring of 1947. The color motion pictures accompanying Dr. Weaver's lecture, which were taken by Richard H. Stewart, staff photographer of the Society, carried the appreciative audience from the take-off of the advance party from Washington, D. C., through the extensive preparations at the camp at Bocayuva, and then through the 3 minutes and 48 seconds of totality. Dr. Weaver explained that although there are some 238 eclipses of the sun each century, only about 66 of these are total. Of the latter, only about 35 can be observed, since many occur in remote and often inaccessible parts of the world.

One of the major projects of the Expedition was carried out by George Van Biesbroeck, of the Yerkes Observatory, University of Chicago. For his measurements of the "Einstein shift" which were designed to test the validity of the theory of relativity, Dr. Van Biesbroeck was awarded the $1,000 Franklin L. Burr Prize, presented to outstanding members of expeditions sponsored by the National Geographic Society. This year's winner, who was present at the lecture, was introduced to the audience by Dr. Shapley, who presided.

High light of Saturday evening was the Presidential Address delivered by James B. Conant, the retiring president of the Association. Following the address, at the Sherman Hotel, officers of the Association received in the Louis XVIth Ballroom. In the receiving line to greet members of the Association and their families were F. R. Moulton, administrative secretary; Edmund W. Sinnott, president of the AAAS for 1948; George D. Stoddard, president of the University of Illinois, who welcomed the AAAS to Chicago; Harlow W. Shapley, 1947 president of the AAAS; and Dr. Conant.

Notice to authors: Effective with this issue, all remittances for reprints should be sent to the Business Office of *Science*, 1515 Massachusetts Avenue, N.W., Washington 5, D. C. Checks should be made payable to the American Association for the Advancement of Science. If reprint order blanks are not returned simultaneously with return of corrected galleys to the Editorial Office, it will be assumed that no reprints are desired.

About People

Lester L. Stout, former staff member of the Technical Laboratory, Organic Chemicals Department, E. I. Du Pont de Nemours and Company, Boston, has been appointed assistant to the director, Ohio State University Research Foundation.

Sir Frank Engledow, Draper's professor of agriculture, Cambridge University, England, has been appointed chairman of the Food Investigation Board, Department of Scientific and Industrial Research, succeeding the late Sir Joseph Barcroft.

Richard L. Meier, research chemist, California Research Corporation, has been appointed executive secretary of the Federation of American Scientists, succeeding William A. Higinbotham, who has been appointed co-chairman, Electronics Department, Brookhaven National Laboratory.

S. W. Edgecombe and G. W. Cochran have recently been appointed to the staff of the Utah State Agricultural College at Logan. Dr. Edgecombe, recently director of research and vice-president, W. Atlee Burpee Seed Company, Philadelphia, joined the staff on December 1 as professor of horticulture and head of the Department. His duties will include heading the horticultural research program in the Experiment Station as well as the teaching work in the College. Dr. Cochran, who became associate professor of plant pathology on January 1, has for the past two years been doing research on virus diseases of stone fruits at the Rockefeller Research Institute. At Utah he will continue this research with a group of scientists working under the direction of B. L. Richards, head of the Department of Botany and Plant Pathology.

Earl H. Newcomer, formerly associate professor of botany, University of North Carolina, is now occupying a similar position at the University of Connecticut, Storrs.

Gordon Nicholas Murray, who was a Captain on the Surgeon's Staff, Headquarters Medical Service, Central Pacific Base Command, during World War II, has been appointed instructor in bacteriology and botany, Department of Biology, University of Tennessee Junior College, Martin.

Vladimir N. Ipatieff was honored on his 80th birthday on November 21 by the Chicago Section of the American Chemical Society in the banquet room of the Furniture Club, Chicago. Gustav Egloff, with whom Dr. Ipatieff has worked in the research laboratories of Universal Oil Products Company for the past 17 years, presented a short speech. The principal speaker was Homer Adkins, professor of chemistry, University of Wisconsin, who discussed many of Dr. Ipatieff's achievements in the field of petroleum, alcohol, and other chemical industries. Members of the Chicago Section of the American Institute of Chemical Engineers and the American Institute of

Chemists joined with the American Chemical Society to assist in the celebration. H. E. Robinson, chairman of the Chicago Section of the American Chemical Society, presided. Dr. Ipatieff, who came to this country at the age of 64, is the only man who has ever been a member of both the Russian and our National Academy of Sciences.

Philip J. Shapiro has recently been appointed instructor in microbiology and physical science at the Monmouth Junior College, Long Branch, New Jersey. Dr. Shapiro's teaching duties will be in addition to his full-time position as chemist in the Micro-Optical Section of the Signal Corps Engineering Laboratories at Fort Monmouth, New Jersey.

Vice Admiral George F. Hussey, Jr., USN (retired), wartime chief of the Navy's Bureau of Ordnance, became administrative head of the American Standards Association (70 East 45th Street, New York) on January 1. As such he succeeds **P. G. Agnew**, who has served the Association for 28 years as secretary and head of the staff. Dr. Agnew will continue to serve as a consultant. **Cyril Ainsworth**, who has been serving as technical director and assistant secretary of the Association, is now director of operations and in this post will be responsible for the greatly increased activities of the engineering staff and the various technical committees.

Grants and Awards

The first annual presentation of **U. S. Department of Agriculture Honor Awards** was made by Secretary Clinton P. Anderson at a special ceremony November 12, 1947, in Washington, D. C. Under the Department's program, Distinguished Service Awards (gold medal and parchment certificate), Superior Service Awards (silver medal and certificate), and Length of Service Awards (miniature shield indicating decade of service) are made.

A number of these awards went to personnel of the Bureau of Entomology and Plant Quarantine:

The Orlando, Florida, laboratory is the recipient of a Unit Distinguished Service Award "for development and application of means of protecting military personnel against attack by insects and diseases spread by insects." The award is to be presented at a special ceremony at a later date.

F. P. Keen, Berkeley, California, was granted a Superior Service Award "for the development of criteria whereby trees likely to be attacked by tree-killing bark beetles could be recognized and harvested before broods of beetles killed them and spread to other trees."

Sievert A. Rohwer, Washington, D. C., was presented a Superior Service Award "for his outstanding service to agriculture through his contribution to the conservation of maximum utilization of the Nation's supply of insecticides during the War, when our source of supply was cut off or seriously restricted by military operations."

The Moorestown, New Jersey, Laboratory received a Unit Superior Service Award "for the development and practical application of the idea of utilizing a disease organism as a method of control of the Japanese beetle." This award was presented to personnel of the Moorestown unit by Under Secretary of Agriculture N. E. Dodd, on November 20 at the Philadelphia meeting of the Eastern Branch of the American Association of Economic Entomologists.

F. C. Bishopp, Ernest R. Sasscer, Bernard Connor, Robert B. Mull, and Elizabeth Ritchie, all of Washington, D. C., were presented Length of Service Awards for 40 or more years of service in the Department as of May 15, 1947.

At a recent meeting of the Board of Trustees of the Nutrition Foundation, Inc., it was announced that, to date, grants-in-aid totaling $1,510,713 had been made for fundamental research in the science of nutrition. The grants have gone to 57 universities and medical centers in the United States and Canada from subscriptions amounting to $3,000,000 from large and small companies in the food industries. At the meeting, 19 new and extended grants-in-aid ($97,150) to 15 universities were authorized. The State University of Iowa was granted $1,800 annually for two years for the study of the intermediary metabolism of tryptophane, under the direction of C. P. Berg; the University of Florida (G. K. Davis), $2,500 annually for two years for the purpose of studying the interrelationship of certain minerals in animal metabolism; the University of Puerto Rico, $2,000 to enable L. J. Roberts and A. T. Blanco to study the response to different levels of vitamin A supplementation in men who have lived for over a year on a diet almost free of vitamin A and carotene; the Children's Hospital, Boston, $5,000 to enable S. Burt Wolbach to study vitamin and mineral deficiencies, and their effect on the bone development of children; Johns Hopkins University, $3,000 to study the influence of hormones on the activity of enzymes and on bone formation, this work to be done by R. M. Archibald; the University of Illinois, $3,600 to enable J. B. Youmans to improve micromethods of evaluating nutritional status; Western Reserve University (Idell Pyle), $1,000 to publish a large amount of data that will be useful to nearly all groups in studies of child development; Duke University, $3,500 for the study of the significance of the parathyroid and of plasma calcium in acid base balance, under the direction of P. Handler; and the University of Rochester, an annual sum of $3,000 for two years to enable N. S. Scrimshaw to study the influence of diet on the complications of pregnancy and on the health of new-born infants.

In addition, grants were extended for studies which are making significant progress at the Universities of California, Illinois, Wisconsin, Minnesota, Cincinnati, and Rochester, and at Yale, Western Reserve, and Tulane Universities.

The U. S. Public Health Service has recently made several grants to the University of California Medical School. The sum of $15,120 was granted for isotopic tracer studies of tissue synthesis and reactions of metabolic antagonists, under the direction of David M. Greenberg; $13,420, for studies on factors influencing growth and development of *E. histolytica in vitro* and *in vivo*, under the direction of Hamilton H. Anderson; $3,454, for studies on serial passage of Hodgkin's disease

extracts and tissues in chicken eggs, under the direction of Warren L. Bostick; and $8,746, for studies of pathologic physiology of polycythemia, under the direction of John H. Lawrence.

Joseph Slepian, associate director, Westinghouse Research Laboratories, will receive the Edison Medal for 1947 from the American Institute of Electrical Engineers, January 28, during its winter convention in Pittsburgh. The award, established in 1909 by associates and friends of Thomas A. Edison, is given annually for "meritorious achievement in electrical science, electrical engineering, or the electrical arts." Dr. Slepian, the 37th winner of the medal, is cited "for his practical and theoretical contributions to power systems through circuit analysis, arc control, and current interruption."

Nominations for the 1948 Intermediate Sugar Research Award will be received until January 15, 1948, according to an announcement by the National Science Fund of the National Academy of Sciences, which administers the awards. The 1948 award, to be made on or about March 15, is the third of four intermediate awards consisting of $5,000, the first having been made to W. Z. Hassid, H. A. Barker, and M. Doudoroff, of the University of California, and the second to Carl F. Cori, of Washington University. The Grand Prize of $25,000, for the most significant discovery of the preceding 5 years, will be presented in 1950. The program was established by the Sugar Research Foundation to stimulate studies of sugar as a food and an industrial raw material.

Entries and requests for further information should be addressed to the Executive Secretary, National Science Fund of the National Academy of Sciences, 2101 Constitution Avenue, N. W., Washington 25, D. C.

Standard Oil Company of New Jersey has contributed $250,000 to the New York University-Bellevue Medical Center Fund (*Science*, September 19, p. 264), $100,000 being designated for the construction and initial equipment of laboratories in the Institute of Industrial Medicine; $500,000 for clinical facilities in the University Hospital; $50,000 in support of the general program; and $50,000 for the support of original research relating to the petroleum industry. The latter amount is to be given in equal annual installments over a period of 5 years, beginning in 1948. Chancellor Harry Woodburn Chase has characterized this as probably "one of the largest capital gifts ever made by a business corporation to further medical education in America."

The Damon Runyon Cancer Research Fund has allocated to the Southwestern Medical Foundation, Dallas, Texas, the sum of $50,000 to be used for cancer research. This sum has been matched by the Variety Club Foundation, which three years ago also donated $12,000 worth of motion-picture machinery, now being used for the production of medical films at Southwestern.

Colleges and Universities

A new undergraduate major in conservation is being developed at Lehigh University in the College of Arts and Science, and classes will begin this spring. The program has been developed over the past two years under the aegis of a faculty committee consisting of Francis J. Trembley, associate professor of biology, at whose suggestion the course was initiated; Bradford Willard, head of the Department of Geology; William J. Eney, head of the Department of Civil Engineering; and Harold P. Thomas, head of the Department of Education. It is designed to provide the students with training in the scientific, economic, and social aspects of natural resources without specialization, which will be carried on in graduate schools or on the job. In the course of preparing the curriculum to be offered jointly by the Departments of Geology and Biology, more than 50 leading U. S. conservationists working in many different fields were consulted by Dr. Trembley. Required courses include English composition, American literature, foreign languages, mathematics, philosophy, physics, religion, chemistry, fine arts, music, cartography, meteorology, and climatology.

Factors influencing the development of hardening of the arteries and high blood pressure will be studied over a period of 10 years by a group of 7 scientists working in the Laboratory of Physiological Hygiene, University of Minnesota, under the direction of Ancel Keys, in a project being supported by the U. S. Public Health Service. In addition to studying the effects of certain habits of diet and physical activity, attention will be focused on effects of worry and tension. Subjects for the study will be volunteers between the ages of 45 and 54, and among the 300 men selected as participants will be a special group of about 30 men who have been exercising systematically over a considerable period. The condition of the hearts and blood vessels of the subjects will be examined thoroughly once each year for 5 years, their physical condition being checked on for the ensuing 5 years. Employees of various Twin City business organizations are being invited to participate.

The Department of Psychology at Northwestern University will offer four graduate-assistant instructorships beginning with the summer session, in a new program designed for training teachers of psychology. The program will be directed by Claude E. Buxton. Instructorships provide full tuition and a stipend of $1,600. Recipients must hold a Master's degree or its equivalent in graduate training. Training will include courses on teaching methods and problems, classroom speech, and voice problems, and a teaching practicum under staff supervision. During the last three quarters, trainees will be allowed to supplement their studies with electives consistent with their fields of specialization in psychology. Further information may be obtained from the Department.

According to Robert H. Seashore, chairman of the Department, postwar plans for developing its staff have been almost completed. The faculty now includes A. Raymond Gilliland, William A. Hunt, Donald B. Lindsley, Thomas W. Richards, and Dr. Seashore as full professors; Claude E. Buxton, E. Lester Clark, Albert C. Van Dusen, and Ruth F. Wyatt (psychology and music) as associate professors; Frank J. Dudek, Carl P. Duncan, Robert L.

French, Robert W. Kleemeier, and Benton J. Underwood, as assistant professors; and Helen Sargent as part-time lecturer. Special seminars in clinical psychology are being offered this year by Samuel J. Beck, of Michael Reese Hospital, and Jules Masserman and Benjamin Boshes, of the Northwestern Medical School, Department of Nervous and Mental Diseases. Work in social psychology is being developed jointly with Kimball Young, chairman of the Department of Sociology.

Visiting professors for the 1948 summer session will include David Grant, University of Wisconsin, who will teach special courses in the area of quantitative methods, and A. T. M. Wilson, director of the Tavistock Clinic, London, who will offer a special seminar in social psychology under joint sponsorship of the Departments of Sociology and Psychology.

The Institution for Tuberculosis Research to be established at the University of Illinois' medical campus in Chicago is to be headed by a five-man Board of Directors. In addition to Andrew C. Ivy, vice-president of the University in charge of the Chicago professional colleges, and John B. Youmans, dean, College of Medicine, the Board membership will include two directors of the Municipal Sanitarium of Chicago and one person elected by the medical directors and representing the Sanitarium and the University. The Institution, which is expected to make a major attack on tuberculosis, will become the Nation's sole source for the manufacture and distribution of the vaccine BCG (bacillus Calmette-Guerin). Research will also be carried on. The State Legislature has appropriated funds for purchase of land, construction of a suitable building, and equipment.

Administrative reorganization of the Indiana University School of Medicine has involved the establishment of a Department of Microbiology headed by Randall L. Thompson (*Science*, November 14, 1947, p. 467) and the elevation of the Divisions of Orthopedic Surgery, Anesthesia, Radiology, and Gynecology to the status of Departments. George J. Garceau, professor of orthopedic surgery and chairman of the Division of Orthopedic Surgery, continues as chairman of the Department. Orthopedist to the James Whitcomb Riley Hospital for Children for the past several years, Dr. Garceau was recently elected president of the Clinical Orthopedic Society. Raymond C. Beeler, professor of radiology, is chairman of the Department of Radiology, a position he has held with the former Division of Radiology. Dr. Beeler is the immediate past president of the American Roentgen Ray Society. V. Kenneth Stoelting has been named chairman of the Department of Anesthesiology and assistant professor of anesthesia. In addition, he is serving as chief of anesthesia for the hospitals of the University Medical Center. Dr. Stoelting has done graduate work in anesthesia at the University of Wisconsin and University of Iowa in addition to four years service in the U. S. Army Medical Corps.

The Department of Entomology, Kansas State College of Agriculture and Applied Science, has recently added to its staff Howard W. Smith, formerly at the University of New Hampshire, as assistant professor of entomology and plant pathology for full-time investigations of new materials supplied by a sponsoring firm for possible uses as fungicides or insecticides; Paul A. Dahm, University of Illinois, as assistant professor for instruction and Experiment Station work; Louis C. Kuitert, University of Kansas, as assistant professor for full-time teaching and as curator of the insect collection; and W. C. Rhoades, Oklahoma A & M College, as graduate assistant. On June 1, W. W. Franklin, Kansas State College, will begin full-time research work in cooperation with the Ft. Hays Branch Experiment Station.

An instrument laboratory which will contain many complicated and expensive instruments capable of solving complex research problems that ordinarily cannot be solved by methods used in standard laboratories is being established at the University of Wisconsin. The laboratory will provide a comprehensive instrumental service which will be available not only to the various departments within the University but to Wisconsin industries which wish their complex technological problems solved without spending thousands of dollars for their own instruments. The State University Board of Regents has accepted a gift of $7,500 from the University of Wisconsin Foundation for the establishment of the service. One of the goals of the Foundation's Centennial Campaign is to raise funds for this purpose. In addition to furnishing the instrumental service to all qualified persons, the University plans to sponsor an annual institute on instrumentation, open to both students and industrial personnel. The instrument laboratory will also train skilled instrument operators. University professors in charge of establishing the service are: C. A. Elvejhem, V. W. Meloche, J. W. Williams, L. R. Ingersoll, K. M. Watson, and J. H. Mathews.

N R C News

The social structure of modern civilization is influenced to an ever greater degree by the discoveries of science and their technological applications. Science is continuously modifying the relations of man to his natural environment and is increasingly affecting the interrelationships of men in social groups. Knowledge has always been dangerous. Scientific knowledge and research offer the alternatives of improving or degrading social life; they can aid in the solution of social problems or they can make them more difficult of solution. "The fundamental issue of our time," as R. B. Fosdick of the Rockefeller Foundation recently wrote, "is whether we can develop understanding and wisdom reliable enough to serve as a chart in working out the problems of human relations; or whether we shall allow our present lopsided progress to develop to a point that capsizes our civilization in a catastrophe of immeasurable proportions."

That the social usefulness of science will depend more and more upon effective cooperation between natural and social scientists is the basic factor which has prompted a new effort to be sponsored by the Carnegie Corporation of New York under the auspices of the National Research Council. Funds have been provided for several postdoctoral fellowships involving tech-

niques of training and study in both a natural and a social science. For natural scientists with a Doctor's degree and some measure of achievement in research, the fellowship will permit two years of supplementary training in one of the social sciences. Social science applicants with similar qualifications must plan for two years training in a supplementary natural science. The opportunity thus provided for a few mature scholars of high quality is based upon the recognition of the social problems arising from scientific and technological advances and on the conviction that social science techniques have applicability in some fields of natural science.

The fellowships will be open to U. S. citizens who hold the Ph.D. in a natural or social science and who have demonstrated their professional competence at least by their graduate records and theses and, where possible, by their achievement in postdoctoral research. The stipends will range from $2,500 to $5,000 per year. All candidates should be nominated by a responsible officer of the institution conferring the doctorate or with which there is present affiliation.

Candidates for these fellowships must supply a proposed program of study and research in a designated field of the social or natural sciences. The program, to be acceptable, should envisage a two-year period devoted to the proposed effort. The institution in which it is proposed to prosecute the study should also be indicated. Fellows will be encouraged to undertake their fellowship work in institutions other than those in which their original training was secured. It is expected that the Joint Fellowship Board in charge of the program will also act in an advisory capacity by assisting the fellows in planning their study and research.

To receive consideration at the next meeting of the Joint Fellowship Board, applications must be filed on or before February 1. The first awards will be announced about March 15. Applications or inquiries should be addressed to the Fellowship Office of the National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

In addition to its chairman, the Board in administrative charge of the program consists of Detlev W. Bronk (*ex officio*), National Research Council; Carlyle F. Jacobsen, State University of Iowa; Robert K. Merton, Columbia University; E. G. Nourse, Council of Economic Advisers; J. Robert Oppenheimer, Institute for Advanced Study; and Donald Young (*ex officio*), Social Science Research Council. (HUGH S. TAYLOR, *Princeton University, Chairman.*)

The availability of RCA Fellowships in Electronics for the year 1948–49 has been announced by the Council. This recently inaugurated fellowship program, supported by the Radio Corporation of America, purposes to give special training and experience to young men and women who have demonstrated marked ability in the general field of electronics, whose preliminary experience may have been either in electrical engineering or physics, and who have demonstrated marked ability in one or more years of graduate work. The fellowships, open only to U. S. citizens, carry stipends ranging from $1,600 to $2,100 per year. Appointments are for one year, but may be renewed for a second year and, in exceptional cases, for a third. The fields of study to be undertaken are in the sciences underlying the general science of electronics. Applications must be filed by February 1. Further details may be obtained upon request from the National Research Council Fellowship Office, 2101 Constitution Avenue, N. W., Washington 25, D. C.

Meetings

"A Progress Report to the Nation" will be the theme of the Chicago Technical Conference to be held in conjunction with the annual Chicago Production Show on March 22–24 at the Stevens Hotel. New processes, discoveries, techniques, and materials will be described to the general public in nontechnical language. Registration for the sessions is expected to be in the neighborhood of 10,000 persons. This Conference is being sponsored by the 51 scientific, engineering, and technological societies affiliated with the Chicago Technical Societies Council, of which Gustav Egloff, director of research, Universal Oil Products Company, is president. According to Royal L. Stapleton, vice-president of the Council in charge of the Conference, plans include radio and television coverage in the Greater Chicago Metropolitan Area.

A Symposium on the Diagnosis of Viral and Rickettsial Infections will be held at the New York Academy of Medicine, beginning the evening of January 29 and continuing through the afternoon and evening of January 30. The program will include: "Influenza," George K. Hirst; "Mumps," Werner Henle; "Psittacosis-Lymphogranuloma Group of Viruses" (including trachoma and inclusion blennorrhea), Geoffrey W. Rake; "Primary Atypical Pneumonia," Frank L. Horsfall, Jr.; "Neurotropic Virus Infections" (including the viral encephalitides, lymphocytic choriomeningitis and poliomyelitis), Jordi Casals; "Herpes Virus," T. F. McNair Scott; "Rabies," Harald Johnson; "Dengue," R. Walter Schlesinger; "Infectious Mononucleosis," John R. Paul; "Epidemic, Murine, and Scrub Typhus as Well as Q Fever," Joseph E. Smadel; "Rocky Mountain Spotted Fever and Rickettsial Pox," Herald R. Cox; and "Infectious Hepatitis," W. Paul Havens, Jr. Chairman of the Symposium is Frank L. Horsfall; and chairman and secretary of the Section are Gregory Shwartzman and Harry Most, respectively.

The Interamerican Society of Cardiology has authorized the meeting of the III Interamerican Cardiological Congress, to be held at the Michael Reese Hospital, Chicago, June 13–17. The meeting will take place just prior to meetings of the American Heart Association (June 18–19) and the American Medical Association (week of June 20). Inquiries regarding the Congress may be addressed to the offices of III Interamerican Cardiological Congress, Michael Reese Hospital, Chicago.

The 12th Christian Fenger Lecture of the Institute of Medicine of Chicago and the Chicago Pathological Society will be delivered at the Palmer House on Monday evening, January 12, by E. V. Cowdry, professor of Anat-

omy, Washington University School of Medicine, and director of research, Barnard Free Skin and Cancer Hospital, St. Louis. Dr. Cowdry's subject will be "Expectations in Cancer Research."

Elections

The Emory University Chapter of the Society of the Sigma Xi, at a business meeting November 24, elected the following officers for the coming year: R. T. Lagemann, president; C. T. Lester, vice-president; A. V. Beatty, secretary; Winfrey Winn, treasurer; A. C. Munyan, custodian; and G. T. Lewis and H. M. Phillips, Executive Committee.

Rear Adm. R. E. Bakenhus, USN (retired), **has been elected** secretary of the American Institute of Consulting Engineers, with offices at 75 West Street, New York 6, New York.

The American Academy of Tropical Medicine, at its 14th annual meeting, held December 3, in Atlanta, Georgia, in conjunction with the meetings of the American Society of Tropical Medicine and the National Malaria Society, elected the following officers: George T. Shattuck, Boston, president; Lowell T. Coggeshall, Chicago, vice-president; Ernest Carroll Faust, New Orleans, secretary; Henry E. Meleney, New York, treasurer; Paul F. Russell, New York, councillor for a 5-year term; and Fred L. Soper, Washington, D. C., councillor for a 2-year term. At the dinner session, the presidential address, "United Attack on Tropical Research," was presented by George K. Strode, Division of International Health, Rockefeller Foundation, New York. The 1947 Theobald Smith Gold Medal was presented to Clay G. Huff, George Washington University, who delivered an acceptance address on "Exoerythrocytic Stages of Malaria Parasites."

The Royal Society, at its 285th Anniversary Meeting in London on December 1, elected Sir Robert Robinson, winner of the 1947 Nobel Prize in Chemistry, as its president for the coming year. At the same time Sir Thomas Merton was elected treasurer; Sir Alfred Egerton and Sir Edward Salisbury, secretaries; and E. D. Adrian, foreign secretary. Members of the Council include J. D. Bernal, W. Brown, S. Chapman, A. C. Chibnall, C. A. Lovatt Evans, W. E. Garner, A. C. Hardy, Sir Norman Haworth, H. D. Kay, C. H. Kellaway, M. L. E. Oliphant, C. F. A. Pantin, H. H. Read, A. E. Trueman, B. N. Wallis, and J. H. C. Whitehead.

The California Academy of Sciences will soon publish a new popular magazine, *Pacific Discovery*, which will be a journal of nature and man in the Pacific World. The new journal, to be published bi-monthly in San Francisco, will be edited by a Board of Editors consisting of Robert C. Miller, director of the Academy, as managing editor; Don Greame Kelley as editor and art editor; and, as associate editors, Wilbert M. Chapman, director, School of Fisheries, University of Washington, Seattle; John L. Kask, curator of aquatic biology at the Academy; A. Starker Leopold, assistant professor of zoology, University of California, Berkeley; Robert T. Orr, Academy curator of birds and mammals; Edward S. Ross, Academy curator of insects; and Ira L. Wiggins, professor of botany, Stanford University. The first issue, dated January–February, 1948, includes the following articles: "Hummingbirds of the Mist," William Beebe; "What Do We Have in Jackson Hole?" Olaus J. Murie; "Evening Skies in Winter," Earle G. Linsley; "Bats: Navigators of the Night," Robert T. Orr; "The Threat to Our Western Ranges," A. Starker Leopold; and "The Mystery of the Disappearing Sardine," Robert C. Miller. Academy members may receive the magazine without additional charge; nonmembers may subscribe at $3.00 per year. *Pacific Discovery* will be the Academy's first periodical publication directed to the general public.

At a meeting of science educators at Harvard University on December 13 establishment of a new organization, the New England School Science Council, was announced. As a first step in its program the Council, which is under the auspices of the American Academy of Arts and Sciences and the Boston Museum of Science, will sponsor a series of science fairs and exhibitions in local secondary schools to stimulate student interest in science and to call public attention to the role of the science teacher in secondary schools. According to Fletcher Watson, of the Harvard School of Education, who is director of the Executive Committee, the purpose of the organization is "to discover New England scientists of tomorrow and assist them toward the advanced training so important for their future and the future of the country." Winners in local fairs and exhibitions around New England will meet in Boston next May for a final regional contest, and winners of this contest will receive certificates of achievement and an opportunity to meet with the American Academy of Arts and Sciences. Assisting Prof. Watson on the Executive Committee are Norman Harris, Boston Museum of Science, executive secretary, and Ralph Burhoe, of the American Academy, treasurer. Headquarters are at 28 Newbury Street, Boston.

Two giant radar mirrors, each approximately 25 feet in diameter, will be utilized by the National Bureau of Standards to intercept and record radio noise generated by the sun, a project complementing studies of cosmic radio noise already in progress. The reflectors are to be located at the Bureau's Radio Propagation Laboratory at Sterling, Virginia, where, by automatic control, they will be directed at the sun constantly throughout the day. Use of increasingly higher frequencies in communication and radar equipment has pointed up the importance of solar and cosmic noise. A report from the Bureau indicates that, as far as radio reception is concerned, three general types of external noise are of scientific interest. One is atmospheric noise, commonly known as "static," originating within the earth's atmosphere. Above 15 megacycles or so, cosmic noise, the second type, becomes noticeable as a low, steady hiss. Cosmic noise, the report states, is generated in the constellation Sagittarius in the Milky Way, its intensity changing slowly as the position of the earth changes with respect to the constellation. Solar noise on the other hand, appears at ultrahigh frequencies, its components being a steady hiss and undulation. It has been found that the variations are some-

times very rapid, taking the form of "puffs" and "swishes" of very short duration. Overlapping swishes result in a grinding noise which affects television reception and, when prolonged, radar operation. The report lists some interesting ways in which data on radio waves of celestial origin might be applied. For example, by analyzing direction and intensity of cosmic noise, it may be possible to study the Milky Way more intensively than is now the case with a telescope. Another application might be in navigating by the sun, without the use of ground stations and on overcast days, by means of a specially built radio sextant which would determine position from the direction of arrival of solar noise.

A program known as "Excursions in Science" is currently under way in Monroe County, New York, under the aegis of a committee organized through the efforts of the Rochester Academy of Science. Primary objective of the program is to acquaint the young people of the county with the various fields of science and the opportunities which they afford. Assisting the chairman of the committee, R. L. Roudabush, head of the Microscopic Department, Ward's Natural Science Establishment, are representatives of the leading civic organizations, educational institutions, and scientific societies of Rochester. According to Dr. Roudabush, monthly meetings are being scheduled and, for the first year, the program will be based on experiences of local scientists and scientific groups. Local institutions provide meeting places. At the first such meeting, held on November 1, the young people were conducted through the new Hall of Optics at the Rochester Museum of Arts and Sciences and, in addition, saw "To Greater Vision," a motion picture furnished by the Bausch & Lomb Optical Company. At the December meeting, held at the Rundel Memorial Library, Arthur Schoen, of the Eastman Kodak Research Laboratory, gave an illustrated lecture on "The Use and Function of the Electron Microscope."

The Office of Technical Services, Department of Commerce, has prepared an index to 831 of the most significant aeronautical research papers of German scientists published between 1939 and 1944, based on the yearbooks published by the two major German aeronautical research organizations, the German Academy for Aeronautical Research and the German Dissemination Center for Scientific Communications on Aeronautics Research. The index also covers papers in related research in electronics, communications, photography, optics, mechanics, chemistry, meteorology, and medicine. Mimeographed copies of the 106-page index, PB–78255, *Report index on German aeronautical research documents,* may be obtained from the Office of Technical Services, Department of Commerce, Washington 25, D. C. for $2.75. Some of the yearbooks and papers listed are available from OTS, and other American depositories are named.

The Electrochemical Society has announced that starting this month it will publish the *Journal of the Electrochemical Society,* which will contain technical papers formerly distributed to members in preprint form and news and affairs of current interest which used to appear in the Monthly Bulletin. The cost of yearly subscription is $7.50, but all members will receive the journal with their memberships. The "Transactions" of the Society will continue to be published and will contain the proceedings, the technical papers issued in the *Journal* and the discussion of these papers which will not be printed in the monthly *Journal.* The cost of "Transactions" this year has been raised to $4.00.

The Division of Rubber Chemistry, American Chemical Society, has established a nation-wide library service to promote scientific investigation in the rubber industry. It will be located at the Bierce Library, University of Akron, where a vast amount of pertinent literature is being centralized and will be made available to cooperating libraries throughout the country, beginning this month. The service will be administered by a committee representing the leading companies in the rubber and chemical industries. Publications may be obtained through the service by applying to any cooperating library, which in turn will obtain the desired material from the University of Akron on a loan basis. The University of Akron may lend a specific journal directly, or may arrange the loan through one of the cooperating libraries. Journals may be supplied either in the original or on microfilm. The initial list of publications has been assembled with the assistance of the Firestone Tire and Rubber Company, the General Tire and Rubber Company, the B. F. Goodrich Company, the Goodyear Tire and Rubber Company, the United States Rubber Company, and the University of Akron. Other libraries having sections devoted to the rubber and plastics field are invited to cooperate, in order that the collection may be as all-inclusive as possible. Libraries interested in participating may write either to the librarian, University of Akron, or to Dr. B. S. Garvey, Jr., Sharples Chemicals, Inc., Philadelphia, Pennsylvania, chairman, Rubber Division's library committee.

Correction

The International Commission on Zoological Nomenclature desires to draw attention to an error in the material it recently issued with respect to proposals submitted to the Commission for the suspension of the *Règles Internationales* (*Science,* November 21, 1947, pp. 487–488). On page 488 (item 11), it was erroneously stated that one of the proposals was for the validation of the name *Raphistoma* Rafinesque, 1815 (Pisces). The application in question was, in fact, that the Commission should suppress the above name and validate the name *Raphistoma* Hall, 1847 (Gastropoda). The Commission greatly regrets any inconvenience which may have been caused by the erroneous entry referred to above. (FRANCIS HEMMING, *secretary to the Commission.*)

Make Plans for—

Society of Automotive Engineers, January 12–16, Detroit, Michigan.

American Academy of Orthopaedic Surgeons, January 24–29, Chicago, Illinois.

American Institute of Electrical Engineers, Winter General Meeting, January 26–30, Pittsburgh, Pennsylvania.

American Society for Horticultural Science, January 29–30, Palmer House, Chicago, Illinois.

TECHNICAL PAPERS

Pathogenicity and Isosterism

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The influence of stereochemistry on modern scientific thinking has led to many interpretations of physical, chemical, and physiological phenomena in terms of molecular structure. This has been true in the search for a chemical interpretation of toxicity. If toxicologists are asked about a possible correlation between pathogenicity and molecular structure, they are likely to say that the evidence is mostly negative. No one questions that the like toxic effect of such diverse substances as alcohol, ether, chloroform, and acetone, for example, all of which produce a state of anesthesia, may be due to similar chemical properties; they are all fat solvents. But this is not a correlation between anestheticity and molecular structure. That there is evidence of a relationship between toxicity and molecular properties is suggested by some biological chemists; for example, the effectiveness of sulfanilamide and *p*-aminobenzoic acid as insecticides is said to be due to the $C_6H_4N_2$ group present in each.

In the search for a correlation between pathogenicity and the physical-chemical properties of the responsible reagents, certain significant properties may have been overlooked. Nothing, so far as I am aware, has been said on the possible relationship between pathogenicity and isosterism.

Throughout my work on the anesthesia of protoplasm, the similarity in the anesthetic effects of carbon dioxide and nitrous oxide was so close and so constant, in comparison to the varying effects of other anesthetic agents, that I, knowing of no chemical properties common to these two gases, sought comparable physical qualities. Such qualities would be particularly appropriate to a theory of anesthesia which attributes unconsciousness to a physical change in the protoplasm, namely, to gelatinization. This theory, which is a slight modification of that of Claude Bernard (*2*), I have supported with considerable visual evidence (*4*).

Certain other agents also gave parallel results. Similarity in the effects of the ordinarily highly toxic carbon monoxide and the relatively inert nitrogen (with a trace of oxygen) was particularly striking. Five hours of constant application of either one of these two gases had no effect on the primitive form of living material used.

When a beginning is made on an hypothesis as broad as the possible correlation between pathogenicity and isosterism, an experimenter is forced to ask his reader to limit his thoughts, for the moment, to the particular material worked upon and the particular reagents under consideration. I am well aware that when other organisms, especially those of higher complexity, and other toxic agents are considered, the hypothesis may not hold. It should be borne in mind, however, that complexity in an organism does not necessarily vitiate—it may only obscure—a correlation. Work on a lowly form of life has the advantage of simplifying the situation sufficiently for the correlation to be revealed.

The living material studied in the experiments reported here was the myxomycete or slime mold, *Physarum polycephalum*. As a slime mold is probably as close an approach to a primordial ooze as any form of life on earth today, *Physarum*, therefore, lacks many of the characteristics of higher organisms; there is no cellular tissue, no well-defined nervous system, and no hemoglobin. However, any protoplasm of lowly form is, after all, living matter—a fact too often minimized. A slime mold is in itself a nervous system. Its response to reagents will be very similar to that of our own protoplasm when the latter is divested of all the intricate accessory mechanisms of higher organisms.

The reactions of *Physarum* to carbon dioxide and to nitrous oxide are identical. The slight variations which occur in the response of the protoplasm to the two gases are no greater than the variations seen in the reaction of two separate cultures of the same species to one of the gases. The protoplasm ceases all visible activity within ½ min. when gas is administered at the rate of 0.2 cc/sec. Recovery, indicated by normal active flow, occurs within ¾–1 min. after the gas is shut off. The rapidity with which the gas is administered and the time the culture is kept under the influence of the gas determine, in part, the time required to produce anesthesia and the time of recovery. Both gases, when judiciously administered, cause no visible injury, no syneresis, no surface breakdown, and no coagulation.

Substances of close chemical relationship are generally grouped on the basis of molecular composition, e.g. the alcohols, the aldehydes, and the esters. Nothing is usually said of the possible similarities of such properties as crystal form, spectrum, surface tension, viscosity, and electronic pattern. Certain of these are collectively known as isosteric properties. When they are given due consideration, an extraordinarily close agreement is found to exist between substances which show no close chemical relationship in either composition or molecular structure. Physical relationships which run counter to chemical ones are present among many substances; thus, Barker (*1*) has shown a great number of cases of isomorphism among crystalline substances, which, according to the usual valence theory, are not closely related. Isosteric substances owe their similar physical properties to similar electronic arrangement. Carbon dioxide and nitrous

[1] I am indebted to my colleague, Marvin Carmack, for suggestions pertaining to certain problems discussed in this article—in particular, the significance of isosteric properties in chemistry.

oxide, which have a like effect on protoplasm, are isosteres. That this is true is shown in Table 1.

It is thus obvious that in their isosteric properties as in their anesthetic or pathological effects on certain lowly organisms, carbon dioxide and nitrous oxide are nearly identical.

TABLE 1

THE ISOSTERIC PROPERTIES OF CARBON DIOXIDE AND NITROUS OXIDE*

	CO_2	N_2O
Number of exterior electrons	22	22
Molecular weight	44	44.02
Viscosity, at 20°C and 1 atm	148×10^{-6}	148×10^{-6}
Critical pressure (atm)	77	75
Critical temperature	31.9°	35.4°
Heat conductivity, at 100°C	0.0506	0.0506
Density of liquid, at –20°C	1.031	0.996
Density of liquid, at 10°C	0.858	0.856
Refractive index of liquid, D line, 16°C	1.190	1.193
Dielectric constant of liquid, at 0°C	1.582	1.598
Magnetic susceptibility of gas, at 16°C and 40 atm	0.12×10^{-6}	0.12×10^{-6}
Solubility in H_2O, at 0°C	1.780	1.305
Solubility in alcohol, at 15°C	3.13	3.25

* Certain discrepancies appear to exist between the values in the foregoing table (in part from Langmuir, *3*) and other recent work. Where the values given by authors differ, the agreement between the two gases CO_2 and N_2O is, nevertheless, surprisingly close. Thus, the dielectric constants in Lange's *Handbook of physics and chemistry* (5th ed.) are 1.000985 for CO_2 and 1.00116 for N_2O, at 0°C and 1 atm. As temperatures and pressures are not always stated, I have kept strictly to the Langmuir values, except for several additions.

Nitrogen and carbon monoxide have no effect on slime mold protoplasm (except for a brief initial injury due to shock, which is not uncommon in treating protoplasm with reagents). These two gases, both the biologically inert nitrogen and the usually active carbon monoxide, have closely similar isosteric qualities. Carbon monoxide poisoning in mammals is due to combination of the gas with hemoglobin. This is a different matter than the effect of the gas on protoplasm which lacks most mammalian characteristics.

That certain properties of protoplasm, not only purely physical qualities such as viscosity and elasticity but complex chemical ones such as respiration, are similar in primitive forms of protoplasm and in higher forms of life, including man, is indicated by the following experiment: A 3- to 5-day chick heart reacts to carbon dioxide in a manner identical to the protoplasm of a slime mold. The chick embryo contains blood not yet distributed in an organized system extending throughout the tissue; yet, though blood is present, the embryo, unlike the adult chick as a whole, reacts as does a primitive form of living matter (*5*).

The correlation between pathogenicity and isosterism may ultimately prove to hold for only a few isolated cases. Gases and other reagents may be found which are not isosteres but to which protoplasm shows similar reaction. However, such a correlation will not have been proved false until two isosteres are found which have wholly different effects on living matter.

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Control of Hemorrhagic Syndrome and Reduction in X-Irradiation Mortality With a Flavanone[1]

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A hemorrhagic diathesis is now believed to be characteristic of the mammal exposed to the ionization of single-dose radiation and, to a lesser degree, to repeated radiation. Following sub- or midlethal doses of total body radiation this bleeding is uncontrollable and is a primary factor in mortality. The disturbance is one of generalized bloody extravasation with oozing into practically every organ and tissue. In the dog, exitus is usually preceded by profound intrapulmonary and/or intraintestinal hemorrhage.

A direct influence of ionizing radiation on vascular integrity has not been proved. Earlier studies have implicated thrombocytopenia as a causal factor in the hemorrhagic picture (*5*).

Recent investigations indicate the presence of an increased quantity of heparin or heparin-like material in the blood of dogs following acute whole-body exposure to ionizing radiations. In these animals certain antiheparin substances, such as toluidine blue and protamine, restored prolonged *in vitro* and *in vivo* coagulation time to normal (*2*). This technique served to halt the hemorrhagic tendency, although all treated dogs succumbed about 22 days after being exposed to 450 r, while control untreated dogs usually died after 11 days (*1*).

As the result of studies in this laboratory it was felt that control of vascular integrity might be of benefit to the organism in which hypocoagulability exists. In this condition, prevention of vascular damage might reduce the hemorrhagic extravasation. It would appear that the function of critical organs already suffering from some degree of direct destruction by ionizing irradiation is further impaired by the bloody ooze of capillary destruction. By maintaining the vascular structure, an in-

[1] This paper is based on work performed under Contract No. W–7401–Eng–49 for the Atomic Energy Project at the University of Rochester. The authors gratefully acknowledge the counsel of A. H. Dowdy, M.D., director, Atomic Energy Project, University of Rochester.

creased opportunity f eventual restoration of organ function should be afforded.

Cognizant of the import of the nonspecific toxicity of massive doses of irradiation and of uncombated infection as causal influences in irradiation mortality, both of which are also under study here, an examination of some

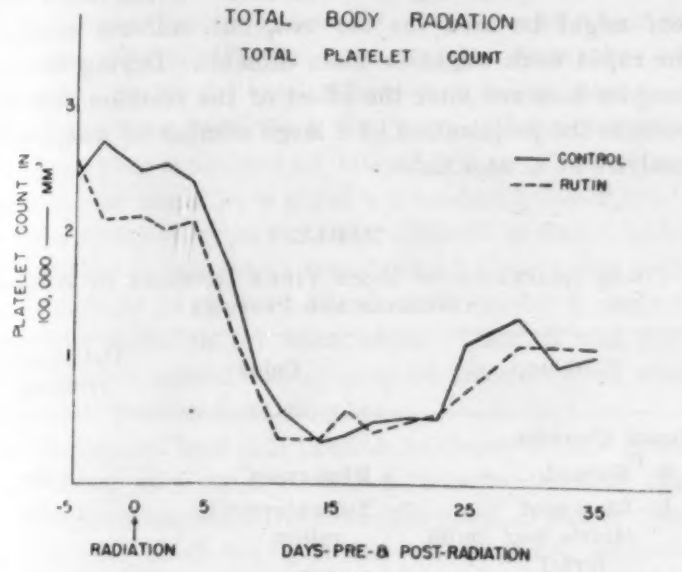

FIG. 1

protective and regulatory factors in maintaining the vascular integrity has been undertaken. The recent availability of the flavanol glycoside, rutin,[2] with which clinical instances of increased capillary fragility were controlled (*3, 4*), prompted its trial. In this preliminary report a summary of some of the data obtained with its use is presented. Details will be given in subsequent reports.

Fifty normal adult dogs similar in size were selected and divided into a control group of 25 dogs and a treated group of 25 dogs. The latter received 50 mg of the glycoside 3 times a day orally, commencing one week prior to irradiation and continuing throughout the course of the test. Except for the administration of rutin, the two groups of dogs were treated identically.

A standard single dose of total-body X-irradiation of 350 r[3] (approximately the midlethal dose) was delivered to each dog used in these tests. Following the irradiation, 16 of the 25 (64%) untreated dogs succumbed in 13–30 days after X-irradiation, whereas only 3 of 25 (10%) rutin-treated dogs died 16, 28, and 31 days postradiation.

Widespread premortem ecchymoses and intrapulmonary and intraintestinal hemorrhages were seen in all 16 untreated dogs which succumbed. Three of the surviving dogs of this group manifested subcutaneous ecchymoses and intestinal hemorrhages. Although characteristic widespread hemorrhage was seen in 2 of the 3 rutin-treated dogs which failed to survive, the 22 remaining exposed dogs were relatively free from petechiae and ecchymoses during the postradiation period of 40–60 days and at autopsy.

Studies of the peripheral blood of the two groups of dogs showed little or no difference in the postradiation depression of the hematological elements, especially the thrombocytes and leucocytes in the treated and control dogs. Illustrating this similarity, Fig. 1 shows the means of the platelets of the two groups of animals.

In the group given the glycoside several dogs were observed to develop a severe thrombocytopenia and leucopenia which persisted for 10–14 days. Recovery eventually ensued. In distinct contrast, recovery in untreated dogs with persistent severe depression of blood elements has rarely been observed in this laboratory.

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A Rapid Chemical Test for Some Plant Virus Diseases[1]

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In a search for possible chemical reactions that might be of aid in the diagnosis of virus diseases of fruit trees, it was found than an alkaline extract of certain virus-infected peach or sweet cherry leaves produced, under certain conditions, a brilliant red coloration. A procedure was developed whereby the reaction could be used as a quantitative measure for some plant virus diseases. Although several thousand tests have been made during the past few months, this report can be of only a preliminary nature pending a more exhaustive study. Nevertheless, it seems desirable to report the procedure at this time because of its potential usefulness.

Thus far most of the studies have been confined to virus diseases of cherry and peach trees, and the discussion that follows is based on work with these plants. Leaf tissue was used as the source for all analytical material. An ordinary paper punch, with a diameter of approximately 6 mm, was used to obtain disks of leaf tissue as samples of standard size. For routine work, only one disk was taken from each leaf, midway between the base and tip and midway between the midrib and margin of the leaf.

[2] A crystalline glycoside of quercetin. Furnished by the Eastern Regional Research Laboratory, Philadelphia, through the courtesy of J. F. Couch, and also by the Abbott Laboratories, North Chicago, Illinois.

[3] Radiation was administered from a Picker Industrial X-ray machine of 250 KVP, 15 ma, 37" t.s.d., and 14.22 mm parabolic aluminum and 0.53 copper filters with a half-value layer for copper of 2.15 mm.

[1] Published as Scientific Paper No. 743, College of Agriculture and Agricultural Experiment Stations, Institute of Agricultural Sciences, State College of Washington, Pullman.

[2] The writer wishes to express his appreciation to E. L. Reeves, Earle Blodgett, Folke Johnson, Leo Campbell, and E. R. Parker for their generous cooperation in supplying known virus material of known identity.

For any one sample from a tree, 5 leaves were used and the results averaged. Each leaf disk was placed in a ½" test tube (standardized for use in a photoelectric colorimeter), and 5 ml of reagent was added. The tube was then heated in a boiling water bath for 5–10 min, allowed to cool for about 10 min, and then shaken thoroughly before a reading was taken in the colorimeter. The disk of leaf tissue either settled to the bottom of the tube or remained at the top of the reagent and therefore did not interfere with the reading. A green filter was used in the results reported here. The color reached a maximum in about 10 min and remained constant for at least 30 min. Normal leaves yielded a blue-green to yellow-green color, while leaves from plants affected with certain virus diseases gave varying intensities of red. Spectrophotometric studies in the visible range showed that maximum absorption differences between normal and virus diseased material occurred in the range of 450–525 mμ. The colorimeter was used to give a more precise estimation of the color, but for rapid qualitative tests, visual observation alone could be used for the detection of some of the diseases.

The reagent is composed of 40 gm of sodium hydroxide, 0.3 gm of cupric sulfate, 3 gm of sodium citrate, and 1,000 ml of distilled water. The sodium hydroxide should be dissolved in one portion of the water, the cupric sulfate and sodium citrate in another portion, and the two mixed after they are dissolved. Copper sulfate seems to catalyze the formation of the red color. Sodium citrate is added to prevent the precipitation of cupric oxide when the reagent is allowed to stand for more than several days. The reagent has a blue color, and a reagent blank should be run on the colorimeter.

The sampling procedure is of the utmost importance, and it is necessary to use discrimination in the choice of leaf samples. Most diseases have distinctive leaf symptoms and, for any one sample, leaves should be chosen that have comparable symptoms. Moreover, leaves of the same "physiological" type should be used. On sweet cherry trees there appear to be two forms of leaves: juvenile leaves, as represented in rapidly growing twigs such as terminal growths and "water sprouts," and adult leaves, as represented on the fruiting spurs. The juvenile leaves tend to be thicker, longer, and narrower than the adult leaves and, even on apparently normal cherry trees, give a fairly strong reaction with the test. Thus, in choosing samples from sweet cherry trees only spur leaves should be used. On terminal branch growths, there usually is a gradation from typically juvenile leaves at the tip to typically adult leaves at the base. It may be possible, by using basal leaves, to obtain adequate samples from young trees that have not as yet attained sufficient spur growths, but further study of this point is needed. Midterminal leaves were used as test material for peach trees. Since all peach leaves appear to be of a single "physiological" type, sampling was not as difficult as in the case of cherry trees.

Leaf samples were normally taken from the midlamina portions of leaves for the reason that virus-infected leaves usually showed a gradient in color reaction from tip to base. Little variation in color reaction was found in the various portions of normal leaves. When midrib samples were taken, they usually gave a much higher reading than the rest of the leaf, particularly in the case of some virus-infected leaves. There is a possibility that if both midrib and midlamina samples were taken, a further distinction of certain viruses might be obtained. Tissue other than leaf might be used for the test, but uniform sampling for rapid work might be more difficult. Drying the leaf samples does not alter the effect of the reaction and thus permits the preparation of a large number of samples for analysis at a later date.

TABLE 1

COLOR REACTIONS OF SOME VIRUS DISEASES OF SWEET CHERRIES AND PEACHES

	Group	Color	Colorimeter reading
Sweet Cherries			
0	Normal	Blue-green	10–20
I	Ring spot Mottle leaf (mild form)	Yellow-green to yellow	25–50
II	Mottle leaf (severe form) Rasp leaf	Reddish-yellow	60–100
III	Rusty mottle Twisted leaf Little cherry	Red	150 and above
Peaches			
0	"Normal" Wart Calico Ring spot Cherry mottle leaf (mild form)	Blue-green	15–30
I	Cherry rusty mottle	Yellow-green	30–40
II	Western X-disease (mild form) Little peach	Yellow to reddish-yellow	50–100
III	Western X-disease (moderate and severe forms)	Red	150 and above

On the basis of the color test, the virus diseases of sweet cherry trees and peach trees, thus far tested, may be tentatively segregated into the various groups as shown in Table 1.

There was little variation in the colorimeter readings of samples taken from normal trees. The standard error on the readings from 5 leaves was always less than 2. In the case of samples from virus-diseased trees, on the other hand, the variation increased in direct proportion to the rise in colorimeter reading. The average readings for any one virus disease, however, were always within a certain range, and the differences between the groups were statistically significant.

With this test it seems possible to distinguish not only between different virus diseases of the same host but also between different forms of the same disease. On cherries, for example, the mild form of mottle leaf gives colorimeter readings ranging from 25 to 35, while the severe

form gives readings of 60–80. The mild form of rusty mottle gives an average colorimeter reading of around 200, while the severe form averages nearly 400. On peaches, the mild form of Western X-disease gives an average reading of around 60; the moderate form, 175; and the severe form, 250.

As shown in Table 1, there seems to be a group of "mild" virus diseases of peaches, the leaves of which do not differ significantly in color reaction from that of "normal" peach foliage. There is a possibility that some of the trees from which the "normal" samples were taken may have contained a "latent" virus. Truly virus-free material might have given a consistently lower reading. On sweet cherries, it is also difficult to find a bearing tree that is completely free from all viruses, but with the spur type of growth there seems to be a certain amount of isolation for some spurs. Thus, it was possible to find "normal" spurs even on trees affected with a "mild" virus such as ring spot.

At the present time it is possible to characterize a given virus disease only by a certain colorimeter reading (or percentage transmission) because the exact chemical compound or compounds that give the color have not yet been determined. Tests on pure chemicals indicate that the color reaction is probably due to polyhydroxy phenols, possibly of the tannin group. Other workers (*1*) have shown that some virus diseases cause an increase in tannin content in the affected plants. Since tannins are recognized as protein precipitants, it seems possible that a virus infection may initiate a defense mechanism within the host plant, leading to the production of tannins.

The only factor known at present to interfere with the test is girdling. Leaves from a girdled branch of a virus-free tree give a red coloration similar to that obtained from some virus-infected leaves. Thus, the mechanism of the test may depend upon the virus causing some disturbance in the phloem of the host plant.

Preliminary studies indicate that the test will probably work on virus diseases of other trees such as apples and apricots, as well as on some virus diseases of berries, including raspberries, strawberries, and blueberries. Time has not permitted a study of the virus diseases of annual plants. Some plants may not be suitable for the particular test described here. Leaf samples of quick decline and psorosis of oranges, for example, do not give a color test. Whether tissue other than the leaf could be used in such cases is not known.

A color test for plant virus diseases would seem to have many potential uses. It should be of great aid in establishing sources of virus-free plant material for propagation purposes, and it should aid materially in the diagnosis of cases of some virus diseases where symptom expression is meager or atypical. It might also serve as a tool in physiological studies of the interaction between virus and host.

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Inhibition of Gastric Ulceration in the Rat by *o*-Hydroxybenzoic (Salicylic) Acid

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It has been shown (*2*) that extensive ulceration develops in the rumen of the stomach of the rat following ligation of the pylorus if the animals have been previously fasted for a length of time which depends upon their age. This ulceration may be inhibited and in some cases entirely prevented by the administration of certain substances. In examining the activity of monohydroxybenzoic acids, one of them was found to have a striking anti-

TABLE 1

Influence of Monohydroxybenzoic Acids on Gastric Ulceration in the Rat*

Exp. No.	Acid administered	Dose/rat† (mg)	Avg. body weight‡ (gm)	Gastric juice (ml)	Ulceration		
					% clear	Average ulceration	Index
1	Saline (controls)		130–109	7.6	0	3.0	3.0
	p-hydroxybenzoic	27.4	129–107	5.3	17	2.2	1.8
	m- " "	27.4	128–108	5.8	0	2.8	2.8
	o- " " (salicylic)	27.4	127–108	3.0	100	0	0
2	Saline (controls)		139–117	5.5	0	3.7	3.7
	Salicylic (*o*-hydroxybenzoic)	9.6	140–115	4.6	0	2.5	2.5
	Salicylic (*o*-hydroxybenzoic)	27.4	141–119	6.5	100	0	0
3	Sodium chloride (controls)	25	136–116	6.1	17	2.2	1.9
	Salicylic	41.4	134–112	2.8	87	0.2	0
	Acetyl salicylic (aspirin)	54.0	133–112	5.6	67	0.3	0.1

* Exp. 1 and 2 female and Exp. 3 male rats fasted 48 hr. before pylorus ligation when the trial substance was administered, and fasting continued an additional 9 hr. The acids were given as their sodium salts at pH 7.2.

† The test doses were administered intraperitoneally in Exp. 1, intravenously in Exp. 2, and *per os* in Exp. 3.

‡ There were 6 rats in each group. The first body-weight average was at the beginning of fasting, and the second, preoperative.

ulcer effect (Table 1). The sodium salts were used and the therapeutic effect obtained whether the compound was administered intraperitoneally, subcutaneously or intravenously. The latter route is usually the best for purposes of comparison. Administration of the active compound by mouth some little time preceding the ligation of the pylorus showed that it is effective when given in this manner.

Data on the antiulcer actvitiy of *o*-hydroxybenzoic (salicylic), *m*-hydroxybenzoic, and *p*-hydroxybenzoic acids

given as their sodium salts are presented in Table 1. The latter two acids have some activity, but it is very small in comparison with *o*-hydroxybenzoic (salicylic) acid. The antiulcer and antigastric secretory activity of various substances may not always go hand in hand; however, salicylic acid is not only a very potent antiulcer agent—it also reduces secretion of gastric juice. Long ago it was reported that sodium salicylate inhibits gastric acid secretion in man (*1*). It is interesting to note that of the three acids only the *o*-hydroxybenzoic acid (salicylic) gives relief in rheumatic fever. Stockman (*3*) showed that both the *m*-hydroxybenzoic acid and the *p*-hydroxybenzoic acid are practically inert as antiseptic and antirheumatic agents.

Acetyl salicylic acid (aspirin) is almost as active as salicylic acid in the prevention of gastric ulceration. The activity of other derivatives of salicylic acid, various dihydroxybenzoic acids, and related compounds is now under study.

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Constitution of Gymnosperm Lignin[1]

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Freudenberg's deduction (*5*) of a benzpyrane ring constitution for gymnosperm lignin has recently been extended by Russell's (*19*) proposal of a polyflavanone structure as its specific form. However, the alleged synthesis offered as evidence is open to doubt (*2*). In fact, for substances such as lignin and its derivatives, which are unresponsive to most criteria for identity save ultimate and functional group analysis, even the best evidence of synthesis is contributory but scarcely conclusive. This is certainly the case when the reaction used is one so little suited to give predictable results as is the aluminum chloride-catalyzed Fries rearrangement, by means of which vanillin monoacetate is claimed to rearrange and condense to a polymer corresponding to gymnosperm lignin.

Evidence of a different and more reliable character has been accumulating in this laboratory, and we are prompted to report, perhaps somewhat prematurely, a summary of our investigations on the structure of lignin derivatives and the tentative conclusions drawn from our observations. The hypothesis that lignin from Western hemlock (*Tsuga heterophyla*) is a polyflavanone and that lignin sulfonic acid may be the polyflavanone 3-sulfonic acid is a concept upon which our experimental program was based as early as May 1947.

The evidence rests upon the use of periodic acid to determine the arrangement of oxygen substituted in the nonbenzenoid portion of lignin and its derivatives; upon the behavior of lignin sulfonic acid and other lignins in methylation and acetylation reactions, with particular attention to the influence of alkali; and upon the chemical and physical demonstration of the presence of carbonyl groups in the nonbenzenoid portion of the lignin molecule.

The use of periodic acid for structural determination of lignin rests upon the fact that lignin sulfonic acid is attacked by that reagent (*14*). It was soon understood that reaction with free phenols can scarcely be extensive, considering the small quantity present (*15*), but the large amount of demethylation with the formation of methanol does demonstrate that the reaction involves the aromatic ring (*14*, *15*, *20*). That phenols contribute to only a minor portion of the reactivity is shown also by the failure to block the oxidation by a single treatment with diazomethane, which should quantitatively methylate most phenolic substituents. Successive methylations with diazomethane fail to eliminate the oxidation until a composition corresponding to $C_9H_{7.75}O_{1.8}(SO_3NH_4)_{0.5}(OCH_3)_{1.52}$ (A) is reached. Reaction with periodate then ceases. Phenolic groups become available for methylation with diazomethane through an equilibrium promoted by alkali, in the presence of which successive methylations give the product (A), containing 19.6% methoxyl. The same number of methylations (five) carried out in neutral solution gives a product with only 14.5% methoxyl. More methoxyl can be introduced by dimethyl sulfate in cold aqueous alkaline solution, as found by Hibbert and his co-workers (*11*). This derivative, which has the composition $C_9H_{7.6}O_{2.2}(SO_3NH_4)_{0.42}(OCH_3)_{2.17}$, is not oxidized by periodic acid. A water-soluble acetyl derivative resistant to periodic acid oxidation has the composition $C_9H_6O_{2.6}(SO_3NH_4)_{0.5}(OCH_3)_{0.9}Ac_{1.2}$. During these reactions no alteration in molecular weight occurs.

Comparisons of the composition of ammonium lignin sulfonate, $C_9H_6O_{2.2}(SO_3NH_4)_{0.5}(OCH_3)$, and its methyl and acetyl derivatives show the introduction of a new oxygen atom for each methylene group.[2] Thus, during the methylation reactions there are added also the elements of water.

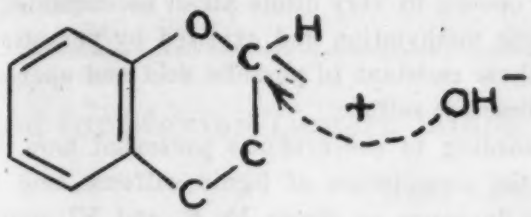
Since neither diazomethane nor cold dilute alkaline dimethyl sulfate will react with any but phenolic groups, phenols must be liberated during the methylations. For this to occur without alteration in molecular weight or change in the generic composition (*i.e.* no fragments lost) can mean only that the phenols are liberated from an intramolecular linkage. This means a ring opening. Assuming the benzpyrane structure, the phenolic libera-

[1] Contribution from Pulp Mills Research Project, University of Washington, Seattle 5, Washington.

[2] Methylation of a phenol adds not a methoxyl, but a methylene, group. Thus,

$$C_6H_5OH + CH_3OSO_2OCH_3 \rightarrow C_6H_5\overset{H}{\underset{|}{O}}CH_3,$$

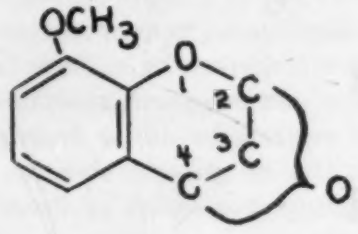
tion by alkali probably occurs through an S_N2 reaction thus:



I

The phenolate ion formed is ready for methylation. According to this mechanism, the new hydroxyl group is on the carbon atom originally bonded through the ether linkage.

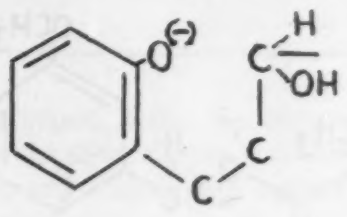
The three oxygen atoms present in a C_9 unit of the lignin derivatives are obviously distributed with two attached to the aromatic ring and the third on one of the three nonbenzenoid carbon atoms, as is shown by isolation of such derivatives as the phenylpropanes (*9*), the propylcyclohexanes (*7*), vanillin (*4*), protocatechuic acid and isohemipinic acid (*3*) from lignin reactions; the arrangement can be generalized thus:



III

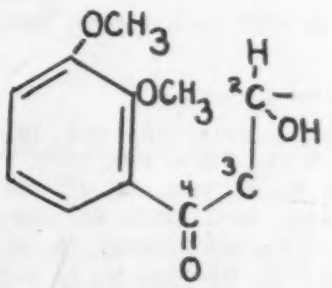
The third oxygen cannot be on carbon atom (2), because then the cleavage by an S_N2 reaction and methylation would give a ketone containing no more oxygen atoms than the original structure. The oxygen atom could then be on carbon atoms (3) or (4), and, as will be seen later, it must be on carbon atom (4).

The third carbon atom appears to be carbonyl. Experiments by Holmberg (*10*) have demonstrated the mercaptol character of a portion of the sulfur linkages in thioglycolic acid lignin by cleavage with acid mercuric chloride and by removal of sulfur on alkaline hydrolysis. We have confirmed this by hydrochloric acid catalyzed exchange between thioglycolic acid lignin and methylal in anhydrous methanol solution (*12*). Indication of carbonyl groups is also furnished by absorption spectra. The spectra of lignin derivatives are known to possess a prominent peak at 2,800 A, a feature shared with several substances containing the guaiacyl acetophenone structure (*13*). By extending our observations to wave lengths below the 2,300-A point, at which previous investigators have stopped, we have worked with a new feature in lignin spectrum comprising a band at 2,150–2,300 A. The 2,800-A peak, which previously has been assumed closely to obey Beer's Law, deviates slightly, and the newly studied absorption band increases in intensity with dilution and with increase in pH; at the same time, the maximum of the band shifts. These features are characteristic of spectra of lignin sulfonic acid, of thioglycolic acid lignin, and of their completely methylated and completely acetylated derivatives. Persistence of the effect is the absence of any other dissociable groups supports assignment of the phenomenon to functional groups involved in keto-enol tautomerism.



II

There is now to be considered the relation between the methylation reactions and the periodate oxidation. Diazomethane reacts under ordinary conditions to methylate only carboxylic acids, phenols or their precursors (*8*), and dimethyl sulfate in cold, dilute alkaline solution reacts only with phenols and flavanones. The elimination of periodate oxidation by reaction with those reagents and the demethoxylation, which accompanies the reaction when it does occur, can mean only that the potential phenolic group was involved in the oxidation. Accordingly, there are present in lignin sulfonic acid no other centers of periodate reactivity, *i.e.*, there are no vicinal aliphatic hydroxyl or carbonyl groups, either in lignin sulfonic acid or in its methyl derivatives. This has an important bearing on the arrangement of the oxygen atoms in these substances. In the methyl derivatives the original nonbenzenoid oxygen and the oxygen atom introduced during methylation cannot be on adjacent carbon atoms. They must then be arranged thus:[3]

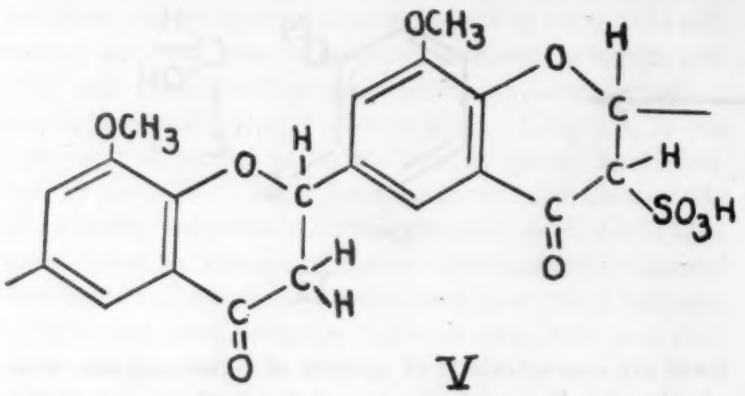


IV

The structure is narrowed down to that shown in IV, and a choice must be made between the unsaturated γ-benzpyrone or flavone structure and the γ-benzdihydropyrone or flavanone constitution. The absence of basic character in lignin derivatives tends to eliminate the flavone from consideration, but the methylation and acetylation reactions can be regarded as decisively indicative of the flavanone structure. Neither in the methylation

[3] This arrangement also rules out all five-atomic heterocyclic rings, since the added oxygen in that case would be on carbon atom (3).

by alkaline dimethyl sulfate of such flavones as myricetin (*16*), quercetin (*18*), or apigenin (*1, 17*) nor in the



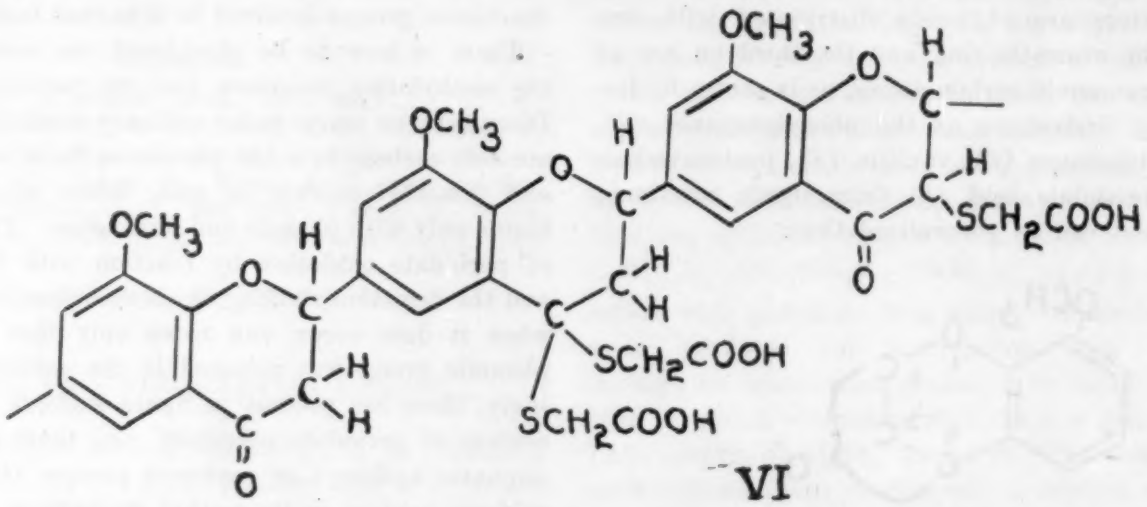
V

sodium acetate catalyzed acetylation of apigenin (*1*) is the ring opened. The products are the methoxy or acetoxy flavones.

genin (*6*). There appear to be in lignin sulfonic acid flavanone rings of two different degrees of lability: (a) those opened by very dilute alkali accompanied by diazomethane methylation and oxidized by periodic acid, and (b) those resistant to periodic acid and opened by alkaline dimethyl sulfate.

According to the evidence presented here, it appears that the constitution of lignin sulfonic acid is that of a polyflavanone as shown by V, and VI represents the analogous thioglycolic acid lignin. It is easily shown that the sulfonic acid group must be on carbon atom (3). If on (2), cleavage should give a ketone bisulfite, and it could be on (4) only as a ketone bisulfite. It has none of those properties.

One verification of the reliability of the polyflavanone structure proposed will be the degree to which the extensive literature on lignin derivatives will be found to



VI

For ring-opening of flavones the more drastic conditions of elevated temperature and concentrated alkali are required. In contrast, ring-opening of the flavanones is easy; for many, only the presence of water or alcohol is required to establish ring-chain equilibrium. Reaction with dimethyl sulfate in cold alkali leads to ring-opening and methylation with such typical flavanones as naringenin (*6*).

conform to its requirements. The case must finally rest upon the results of quantitative degradation reactions carried to a point where, by means of tractable compounds, the criteria of identity can be met. It is work toward that objective which has been in progress in this laboratory for the past three years and which is proceeding to fruition.

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IN THE LABORATORY

A Method for Making Lantern Slides

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Professional workers often have the problem of preparing illustrations for a lecture to a lay or technical audience. The decision regarding the number of lantern slides to be used rests frequently upon three factors: (a) the available funds, a consideration rarely negligible at academic institutions, particularly when slides are to be shown on a single occasion; (b) facilities for preparation of reproducible drawings; (c) the availability of prompt photographic service (capable of filling last-minute orders). The end result is often a great dearth of illustrations and a crowding of information on a few slides. This latter usually leads to illegibly small print of letters or numbers.

The effective lecture appeals to the visual rather than the auditory comprehension of an audience. Particularly, the merely oral mention of numerical values or the description of conditions, arrangements, trends, etc., generally leave too much to the imagination of the listeners and tax their retentive capacity to such an extent that they find it difficult to follow subsequent statements or reasoning. Therefore, the generous employment of lantern slides is highly desirable. In most cases, it is not necessary to exhibit masterpieces of draftsmanship. Legibly printed words or numbers, schematic sketches of diagrams, and even cartoons serve in good stead.

The author happened upon a direct method of making slides which eliminates the expensive photographic process and may be useful to others.

Typing on cellophane, with an inverted sheet of carbon paper on the back side for increased density of the print, is probably a well-known expedient. The results of this method are, however, often disappointing because of unwanted carbon adhering to the cellophane or because of smudges from the typewriter ribbon. Also, cellophane does not offer a good drawing surface.

A more versatile and convenient material for making slides is available in "Permafilm (dull),"[1] a cellulose acetate with a dull finish on one side and an adhesive on the other. When this film is smoothly applied to a slide cover glass, it exhibits a high transparency and facilitates the writing, drawing, or copying of diagrams onto the slide.

While India ink is the most efficient medium for writing and drawing, ordinary pen and ink, soft pencil, or carbon pencil will also give very satisfactory results. All of these media can easily be erased or wiped off with a piece of moist tissue paper. After the desired information has been put on the slide, a mask and another cover glass is placed on top and binding tape applied as usual. Heat from the projector lamp apparently does not affect the film even during prolonged exposure.

[1] Formerly "Dulseal," by Denoyer-Geppert Company, Chicago, Illinois.

Glass Trough for Filter Paper Partition Chromatography

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With the increasing use of filter paper in partition chromatography (*1–4*) has come a need for a trough to serve as a reservoir into which the filter paper dips. The solvents used and the necessity for the avoidance of impurities practically demand glass as a material for the trough.

Using the tools available in most laboratories, a suitable glass trough (Fig. 1) may be constructed in accordance with the following variation in the method described by Consden, Gordon, and Martin (*1*).

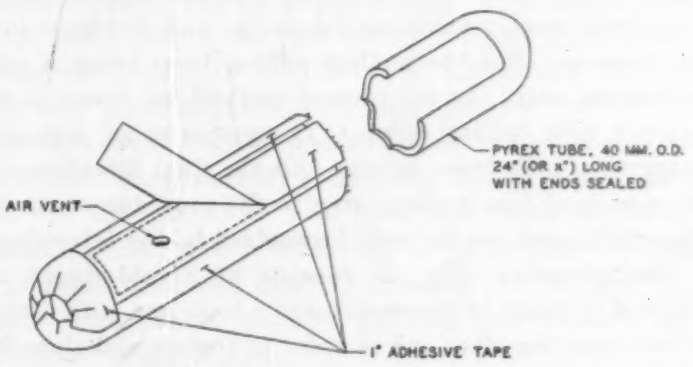

FIG. 1. Diagram of glass trough. *Left:* before cutting; *right:* completed channel.

Seal off the ends of a 40-mm O.D. pyrex tube of desired length, providing a small vent on the side of the tube to equalize air pressure while sealing the second end. Affix to the tube a 1″-wide strip of adhesive tape the length of the trough opening, covering the vent. Affix 4 more strips of tape adjacent to each side and each end of the first strip, but ¼″ distant from it, to form a path on the glass for the cutter and a reinforcement for the tube during cutting. Lay the glass tube on a sponge-rubber mat on a flat sink drainboard, and cut the glass with a carborundum disc, 2″ or smaller in diameter, mounted on a flexible-shaft power take-off, a moto-tool, or a dental engine arm; play a stream of water on the disc and glass while cutting. When the panel of glass has been cut around, it will probably fall off intact. Smooth the

edges carefully with the side of the carborundum disc. A 24″-long trough may be completed in an hour.

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A Simple Micromethod for Rapid Extraction of Lipids[1]

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Ever since Soxhlet's (1848–1905) extractor came into general use, many modifications of the fundamental method have been proposed. The problem has been how to extract all the lipids as completely as possible without undue expenditure of time and exposure of the tissue and extract to oxidation. Recently Bloor (*1*) recommended boiling 95% ethanol followed by ethyl ether as the most generally useful solvent in the microdetermination of lipids. The tissue is boiled in an Erlenmeyer flask and the extract separated from the tissue by filtration. Ernst (*2*) uses a sintered-glass plate fused into a separatory funnel for rapid and repeated extraction of fats from meat, combining extraction and filtration into one process. But the method suffers from being a cold extraction only. In the present method the tissue is extracted with boiling solvent, the processes of repeated extraction with fresh solvent and the final filtration are all combined into a single step in the procedure, and the apparatus used can be easily assembled in any laboratory.

The extractor (Fig. 1) consists of a cold finger, A, the end of which is drawn out into a hook and with a bulb blown near the other end in order to rest on and close the mouth of a 100-ml Kjeldahl digestion flask, B. A thin glass rod, C, with a hook on its upper end, is attached on the lower end of the cold finger and leads into a glass tube, E, placed inside an insect vial, D. The inner tube, E, is made from a 6-cm section of ordinary glass delivery tube with a coarse, sintered-glass plate fused onto its bottom. (The sintered-glass plate used here was made by pulverizing a piece of glass tube and fusing the powder onto one end of a 6-cm section of the same material.) The insect vial, D, has a round opening, F, blown out at its lower third.

For microextraction of lipids from tissue the latter is placed in the inner sintered-glass tube, E, which is placed inside the vial, D. The whole is introduced into the Kjeldahl flask with the help of a glass rod while the apparatus is in a horizontal position. Ten–20 ml of redistilled 95% ethyl alcohol is poured slowly into the flask. After clamping the flask and starting the circulation of water through the cold finger, the bottom of the flask is gently heated with a microflame. As the alcohol boils, its vapor is condensed on the cold finger and flows along the guiding rod, C, into the inner tube, E, and onto the tissue which is being boiled at the same time. Condensed alcohol will at first accumulate in the inner tube, E, extract the lipids, and be filtered into the outer tube, D, through the sintered-glass plate. As soon as the alcohol in tube D reaches the level of the opening, F, it flows out

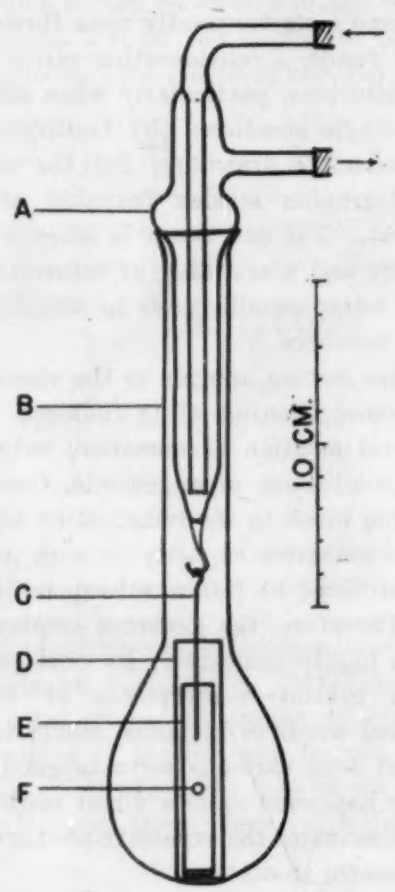

Fig. 1

into the flask. In this way the solvent in tube D is never higher than the level of F, while fresh condensate keeps on coming into the inner tube to extract the tissue. After a specified time the extract is removed from the tubes and the flask. A cork mounted on the end of a 25-cm-long glass rod is convenient for taking the outer tube, D, with its contents, out of the flask. The extraction is completed with ethyl ether in the same way.

In charging the tube with tissue and in removing the extract, precaution is observed against introducing foreign lipids from either the operator's hands or other objects. As some air is always trapped under the vial, D, which then serves as a boiling tube, there is no danger of bumping, for the solvent boils smoothly.

The total extracts recovered after evaporating the solvents under reduced pressure, extracted from different tissues for various length of time (5–20 min), are shown in Table 1. There is apparently no gain in increasing the

[1] Contribution No. 409 of the Woods Hole Oceanographic Institution, Woods Hole, Massachusetts.

[2] This work was done at the Marine Biological Laboratory as a part of a research program. I am very grateful to the chairman and members of the Osborn Zoological Laboratory for providing laboratory facilities at Woods Hole.

time of extraction from 10 to 20 min. On the other hand, there seems to be an actual loss in total extract, as shown in the lower half of Table 2, when the time is greatly

TABLE 1

LIPID EXTRACTS FROM DIFFERENT TISSUES OF STARVING *Fundulus heteroclitus* AND *Tautoga onitis*

Tissue	Extraction time (min)	Wet wt. of tissue (mg)	Wt. of extract (mg)	%	Average %	Deviation from average (%)
Brain, *F. heteroclitus*	20	54.1	6.3	11.6	12.6	−1.0
	15	42.8	5.3	12.4		−0.2
	10	29.5	3.8	12.9		+0.3
	5	40.7	5.5	13.5		+0.9
Liver *F. heteroclitus*	20	83.4	13.1	15.7	16.4	−0.7
	15	75.3	12.2	16.2		−0.2
	10	55.3	8.9	16.1		−0.3
	10	46.9	7.7	16.4		0
	5	57.5	10.0	17.4		+1.0
Muscle, *F. heteroclitus*	20	246.6	6.7	2.7	2.8	−0.1
	15	149.5	4.7	3.1		+0.3
	10	173.9	5.1	2.9		+0.1
	5	260.8	6.8	2.6		−0.2
Liver, *Tautoga onitis*	20	130.6	7.3	5.6	5.55	+0.05
	15	92.8	5.0	5.4		−0.15
	10	74.5	4.5	6.0		+0.45
	5	97.7	5.1	5.2		−0.35

prolonged. This loss is probably due to the removal of volatile fatty acids during prolonged boiling. Extraction made for 10 min with this apparatus gives very consistent results, as shown in the upper half of Table 2, where the deviation in the four samples is not more than 0.3% from

TABLE 2

LIPID EXTRACTS FROM FISH LIVER

Tissue	Extraction time (min)	Wet wt. of tissue	Wt. of extract	%	Dev.
Tautog liver	10	275.1	30	10.9	+0.1
	10	238.3	25.8	10.8	0
	10	282.1	29.6	10.5	−0.3
	10	276.9	30	10.8	0
			Average	10.8	
Fundulus liver	10	34.5	7.6	22	
	20	39.0	7.4	19	
	40	46.3	8.5	18.3	
	80	37.9	6.0	16	

the mean value. For comparison, a piece of the liver from the same tautog was subjected to the classical method of Soxhlet extraction, and the following results were obtained:

Time of extraction in hours	1	2	3	4	5	6
Lipids recovered (%)	4.9	8.0	8.5	9.1	9.5	10.5

Compared with these data from Soxhlet extraction, the results obtained with the present apparatus show that the amount of lipid extracted is not less than the older method, but the saving of time and solvent is obvious.

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Use of the Freezing-Drying Technique for Study of Vasomotor Activity

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The freezing-drying technique has been adequately discussed by Simpson (*2*) and by Flosdorf and his collaborators (*1*), but it has not been used for preservation of vasomotor pictures in histological preparations. Direct microscopic observation of the smallest arteries and arterioles responding to stimulation was found possible by utilization of the method following intravenous administration of autonomic drugs with resultant vasomotor responses.

In these preliminary experiments 22 white rats under Nembutal anesthesia were used. The abdomen of each animal was opened sufficiently to allow extraction of a loop of duodenum. Following drug administration, a duodenal loop was immersed directly in a small Dewar flask filled with a mixture of dry ice and acetone at a temperature of −70° to −78° C. This rapidly froze the gut and preserved the vasomotor picture. While still frozen, a small piece of duodenum was cut off and placed in a test tube previously cooled in a freezing bath of dry ice and acetone. The test tube, still immersed in the freezing bath, was attached to a "Duo-Seal" vacuum pump and the tissue fixed by freezing and drying. Sections were cut in paraffin at 10 μ and stained with toluidine blue and eosin.

In small pieces of duodenum frozen after injection of atropine sulphate (1 cc of a 1:1,000 solution) into the femoral vein, the arteries in the subserosa and the arterioles in the submucosa of the gut were constricted. The capillary beds in the villi contained a small amount of blood. Following administration of ergotoxine phosphate (0.5 cc of a 1:1,000 solution), the arteries and arterioles were dilated, and the capillary beds in the villi were engorged with blood.

Quick freezing of blood vessels and fixation by freezing and drying preserves physiological pictures in histological preparations and is suggested as a method for use in studies of vasomotor activity and similar histophysiologic phenomena.

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Book Reviews

Studies in hydrodynamics and structure of stars and planets. Jeremi Wasiutynski. (*Astrophysica Norvegica,* Vol. IV.) Oslo, Norway: A. W. Brøggers Boktrykkeri, 1946. Pp. vxi + 497. (Illustrated.) Norw. Kr. 50,00.

The author's purpose in writing this book was to show the usefulness, in astrophysics, of physical hydrodynamics, applied nowadays mainly in dynamical and theoretical meteorology. The almost 500 pages of his book give an excellent proof of the great importance of hydrodynamical research for problems of the structure of stars and planets.

In the first chapter the author presents as an introduction a quite general theory of turbulence, extending the classical method of O. Reynolds. Using the concept of Prandtl's theory of mixing length and modifying Taylor's vorticity transport theory, he develops general expressions for all important quantities defining the turbulent motion (as turbulent friction force, turbulent flux of heat, Reynolds' stresses for spherical coordinates, etc.) as well as the condition for full development of turbulence, corresponding to the known Reynolds criterion.

In the second chapter large-scale currents in stars, especially the hydrodynamics of solar activity, are discussed. In order to simplify the problems from the mathematical point of view, the author introduces many assumptions, transforming the general theory of turbulence to the well-known theories of Taylor, Solberg, Høiland and others. These simplifications are far from being plausible or realistic, and it is most surprising that his theoretical results agree well with observed facts, even though he assumes the central core of the sun rotating as a rigid body and the outer layers rotating quite independently. This assumption could hardly be fulfilled with respect to all frictional and mixing effects at the inner boundary between these layers. This fact with some others—for example, that in large-scale motions the horizontal mixing has definitely greater importance than vertical mixing, which forms the basis of all Wasiutynski's consideration owing merely to the very small vertical width of layers in question compared with the horizontal dimensions—will probably lead to a very important discussion and revision of all theories explaining large-scale motion in the interiors or surfaces of stars.

The next chapters (4 and 5) contain the theory of convection currents of Bénard-Rayleigh types with very interesting applications to the theory of solar granulation and the formation of the lunar craters, as well as in the study of the evolution of the surface features of the Earth and Mars. The various features of planetary crusts may be explained as resulting from hydrodynamical processes in the interior of the planet before and after solidification.

In Chapter 6 the mathematical theory of Bénard-Rayleigh convection currents is extended for spherical rotating layers of gas heated from below and attracted toward the center, and the problems of planetary atmospheres in general are discussed.

The last two chapters, which form the culmination of the whole book, are devoted to the problem of stability of radiative equilibrium in stars and, finally, to stellar structure and evolution. Assuming that all stars have similar outer layers (composed mainly of hydrogen), the author discusses in detail four possible stellar models according to the kind of equilibrium (radiative or convective and adiabatic) in the hydrogen-helium layer and in the layer next below. These chapters, as well as all preceding ones, present so many new suggestions, conclusions, and even theories, that all those interested in such astrophysical problems as stellar structure and evolution should find much of interest in this book. The first chapters might also be of interest to those concerned with problems of turbulence and general circulation in the Earth's atmosphere. The only handicap to the latter group is a different terminology from that used in books and papers in dynamical and theoretical meteorology. Finally, Chapter 5, containing a very complete discussion of mountain formation (important in the theory of formation of the Earth's crust) should not escape the attention of geologists.

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ANDREWS, W. B. *The response of crops and soils to fertilizers and manures.* State College, Miss.: Author, 1947. Pp. xv + 459. (Illustrated.) $4.50.

COOK, DONALD. *Ulcer: the primary cause of gastric and duodenal ulcer: diagnosis, medical and surgical treatment, prevention.* Chicago: Medical Center Foundation and Fund, 1947. Pp. xiii + 187. (Illustrated.) $5.00.

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